NAVAL POSTGRADUATE SCHOOL

Monterey, California

THESIS

SURFACE SHIP MAINTENANCE PLANNING PROCESS

by

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December 1991

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REPORT DOCUMENTATION PAGE

1a REPORT SECURITY CLASSIFICATION Unclassified	1b RESTRICTIVE MARKINGS
2a SECURITY CLASSIFICATION AUTHORITY	3 DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.
2b DECLASSIFICATION/DOWNGRADING SCHEDULE	
4 PERFORMING ORGANIZATION REPORT NUMBER(S)	5 MONITORING ORGANIZATION REPORT NUMBER(S)
6a NAME OF PERFORMING ORGANIZATION Naval Postgraduate School 6b OFFICE SYMBOL *(If applicable)* 55	7a NAME OF MONITORING ORGANIZATION Naval Postgraduate School
6c ADDRESS *(City, State, and ZIP Code)* Monterey, CA 93943-5000	7b ADDRESS *(City, State, and ZIP Code)* Monterey, CA 93943-5000
8a NAME OF FUNDING/SPONSORING ORGANIZATION 8b OFFICE SYMBOL *(If applicable)*	9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c ADDRESS *(City, State, and ZIP Code)*	10 SOURCE OF FUNDING NUMBERS Program Element No / Project No / Task No / Work Unit Accession Number

11 TITLE *(Include Security Classification)*
Surface Ship Maintenance Planning Process

12 PERSONAL AUTHOR(S) DeWitt, Amy Murphy

13a TYPE OF REPORT	13b TIME COVERED	14 DATE OF REPORT *(year, month, day)*	15 PAGE COUNT
Master's Thesis	From To	December 1991	129

16 SUPPLEMENTARY NOTATION
The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

17 COSATI CODES			18 SUBJECT TERMS *(continue on reverse if necessary and identify by block number)*
FIELD	GROUP	SUBGROUP	Maintenance, Availability, Planning, Surface Ship

19 ABSTRACT *(continue on reverse if necessary and identify by block number)*

An effective and efficient surface ship maintenance policy and program has long been the goal of Navy planners. There currently exists several programs to assist in the planning and execution of surface ship maintenance and modernization availabilities, all in support of accomplishing repairs at the lowest required level and least cost. The key to a well maintained fleet is a well planned and properly executed maintenance and modernization program. The final product of all of the planning, assessing and inspecting required prior to the start of availability is the Ship Alteration and Repair Package (SARP). The SARP is the compilation of all work assigned for accomplishment during an availability. The package is compiled by Planninbg for Engineering and Alterations (PERA) from the Current Ship's Maintenance Project (CSMP) and authorized SHIPALTs and approvwed by the Type Commandr to help plan and manage work definition and work package development and identifies some problems in current implementation of the process.

20 DISTRIBUTION/AVAILABILITY OF ABSTRACT	21 ABSTRACT SECURITY CLASSIFICATION	
☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS REPORT ☐ DTIC USERS	Unclassified	
22a NAME OF RESPONSIBLE INDIVIDUAL Larry R. Jones	22b TELEPHONE *(Include Area code)* (408) 646-0431	22c OFFICE SYMBOL AS/JN

DD FORM 1473, 84 MAR .83 APR edition may be used until exhausted
All other editions are obsolete

Approved for public release; distribution is unlimited.

Surface Ship Maintenance
Planning Process

by

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Submitted in partial fulfillment
of the requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
December 1991

Author: _____
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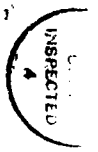
ABSTRACT

An effective and efficient surface ship maintenance management policy and program has long been the goal of Navy planners. There currently exist several programs to assist in the planning and execution of surface ship maintenance and modernization availabilities, all supposedly in support of accomplishing repairs at the lowest required level and least cost. The key to a well maintained fleet is a well planned and properly executed maintenance and modernization program. The final product of all the planning, assessing and inspecting required prior to the start of availability is the Ship Alteration and Repair Package (SARP). The SARP is the compilation of all work assigned for accomplishment during an availability. The package is compiled by Planning for Engineering and Alterations (PERA) from the Current Ship's Maintenance Project (CSMP) and authorized SHIPALTs and approved by the Type Commander. This thesis examines the various resources available to the ship's Commanding Officer and the Type Commander to help plan and manage work definition and work package development and identifies some problems in current implementation of the process.



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I. INTRODUCTION

A. STATEMENT OF THE PROBLEM

An effective and efficient surface ship maintenance policy and program has long been the goal of Navy planners. Several programs currently exist to assist in the planning and execution of surface ship maintenance and repair availabilities, all supposedly in support of accomplishing maintenance and repairs at the lowest organizational level capable of performing the work at the lowest cost possible. The key to a well maintained fleet is a well planned and properly executed maintenance and repair availability program. The final product of all the planning, assessing and inspection required prior to the start of an availability is the Ship Alteration and Repair Package (SARP). The SARP is the compilation of all work assigned to be accomplished during an availability. This package is compiled by Planning for Engineering and Alterations (PERA) and approved by the Type Commander (TYCOM). This thesis examines the various assets available to the ship's Commanding Officer and the Type Desk Officer to help prepare for the SARP development.

The Surface Ship Maintenance Division, Naval Sea Systems Command has been tasked to develop better procedures than those currently used to assess the need for maintenance on

surface ships. At issue is the adequacy of current procedures related to the task of providing adequate data or methods for determining with a high degree of certainty when and whether maintenance is required. Existing procedures also are being challenged on their adequacy for cost control in a resource constrained budget environment, and whether they satisfactorily translate maintenance requirements into costs for use in program and budget justification. The initial step in responding to these concerns is to analyze the current procedures employed for constructing, approving, authorizing and funding maintenance and repair of surface ships.

B. DEVELOPMENT OF THE RESEARCH QUESTIONS

This thesis This thesis documents the surface ship maintenance planning process. It examines the various resiurces available to the ship's Commanding Officer and the Type Commander to help plan and manage work definition and work package development and identifies some problems in current implementation of the process. The thesis focuses on the following questions:

1. What procedures are involved in work package development prior to the Work Definition Conference?
2. Where does the ultimate responsibility lie for work assignment and accomplishment?

3. In what areas of work package planning do problems with implementation of established procedures exist?

4. What areas are recommended for further research?

C. METHODOLOGY

Basic data for this thesis was obtained from existing Navy instructions, notices and policy manuals on ship's maintenance and through field interviews with personnel in the maintenance process. Research was conducted in four major steps:

1. Interviews with Naval Sea Systems Command Detachment, PERA (SURFACE); Naval Sea Systems Command (NAVSEA) (SEA-915/935); Commander Naval Surface Force Pacific (CNSP)(N-4); Port Engineers (N4PE); Commanding Officer, Naval Surface Forces Pacific Readiness Support Group (RSG)(00); CNSP MRMS Specialist (N412).

2. Examination of each step involved in PERA preparation of the Ship Alteration and Repair Plan (SARP) by perusal of official documents, supplemented by interviews.

3. Evaluation of the role of Assessment of Equipment Condition (AEC) and Performance Monitoring Teams (PMTs) and the part they play in the work definition process.

4. Evaluation of the role of the Port Engineer and the potential of this position to provide continuity from availability to availability, as well as among the ship classes.

The resulting research provides a consolidated look at the different maintenance philosophies currently employed and how they relate to the work definition process and the ship's overall material condition.

This thesis provides background on the Navy's maintenance philosophy, maintenance organizations, and maintenance strategies and actions and traces the work package development process from beginning to end. The roles of various assist teams and the utility of the inspections they perform is analyzed for each maintenance strategy. Recommendations for potential areas of further research are made.

II. BACKGROUND ON SURFACE SHIP MAINTENANCE AND REPAIR IN THE NAVY

A. RESPONSIBILITIES

The Chief of Naval Operations (CNO) is responsible for maintaining the overall readiness of naval forces. This responsibility includes planning and programming the resources required for maintenance and modernization of the Operating Forces of the Navy. The CNO and the Navy (OPNAV) Resource Sponsors (OPs-02, 03, and 05) approve all maintenance strategies, ship Class Maintenance Plans (CMPs), the Fleet Modernization Program (FMP), and the depot level maintenance schedule. [Ref. 1]

As the CNO point of contact for Navy-wide ship maintenance issues, OP-32 (a) coordinates maintenance strategies, CMPs, and the FMP with the Resource Sponsors and (b) promulgates the notional durations and intervals for depot level maintenance [Ref. 2]. The depot level availability schedule is developed and issued by Commander, Naval Sea Systems Command (COMNAVSEASYSCOM) after coordination with the Resource Sponsors and the Fleet Commanders.

OP-945 coordinates the maintenance information architecture and expedites the interchange of maintenance

and modernization data for use at headquarters and each maintenance level.

The Fleet Commanders-in-Chief (FLTCINCs) are responsible for the material condition of their assigned ships. This responsibility includes the requirement to make trade-offs among cost, schedule and mission in assigning repairs and modernization availabilities and expending the maintenance funds required to maintain material readiness based on (1) anticipated threat, (2) systems command established technical requirements, and (3) CNO policy. FLTCINCS are also responsible for developing availability work packages and integrating repair and modernization.

COMNAVSEASYSCOM, as the lead System Commander for maintenance and modernization, is tasked with (1) developing and assessing the long range effectiveness of Class Maintenance Plans and revising them as require; (2) supporting FLTCINCs in scheduling ships for depot availabilities; (3) implementing the FMP; (4) providing up to date technical manuals; (5) providing the Program Support Inventory Control Point (PSICP) with material requirements in sufficient time to ensure fleet supportability; (6) commanding the naval shipyards and Supervisor of Shipbuilding, Conversion and Repair (SUPSHIPs); (7) ensuring naval shipyards and SUPSHIPs execute ship maintenance and modernization within the scope of work authorized; and (8)

coordinating with the TYCOMs private sector depot level availability assignment and contracting. [Ref. 1].

B. GENERAL SHIP MAINTENANCE AND REPAIR POLICY

CNO has set the following criteria as general policy for maintenance of ships [Ref. 1]:

a. The Fleet will be maintained in a manner fully capable of meeting the expected threat and in a material condition sufficient to allow the ability to accomplish assigned missions.

b. Maintenance programs are executed in a manner which provides required operational availability. Maintenance actions will be accomplished at the lowest practicable and authorized level taking urgency, priority, capability, capacity, and cost into consideration.

c. The maintenance of ships is considered a continuing process, encompassing all levels of the chain of command and utilizing various tests, programs and availabilities as specific components of the maintenance process.

d. Maintenance actions are either preventive or corrective. Preventive maintenance actions are selected so as to maximize the reliability of ships and to minimize the total maintenance workload.

e. Each new ship design includes a Class Maintenance Plan and Modernization Policy document which will describe the specific maintenance programs (including required maintenance availabilities) applicable to the class, the interrelationship of maintenance and modernization, and any unique program features. Class Maintenance and Modernization Policy documents may be generated for older ships on a case basis.

f. Class Maintenance Plans are developed for each ship class following the concepts of reliability centered maintenance (RCM). The goal of this process is to

accomplish maintenance necessary to achieve maximum operational availability at lowest practical cost.

g. Every ship is assigned a planned maintenance package which describes all required preventive maintenance to be accomplished by the organizational level.

h. Intermediate maintenance activities (IMAs) are FLTCINC assets utilized for accomplishment of repair and modernization beyond the capability or capacity of the organizational level (ship's force) but not requiring depot level assets.

i. Depot level maintenance activities are part of the shore establishment (naval and private shipyards and other designated overhaul points) or FLTCINC assets (Naval Ship Repair Facilities) that perform repair and modernization work.

j. All logistics required for the support of maintenance during the life of new ships or classes are identified, and resources programmed and budgeted sufficiently in advance of ship deliveries to ensure that all required maintenance logistics support is in place either upon ship delivery or earlier.

k. Repairs, maintenance, and modernization of the propulsion plants in nuclear powered ships beyond the capability or capacity of the organizational level are assigned only to nuclear capable shipyards or nuclear capable intermediate maintenance activities.

C. NAVY SHIP MAINTENANCE STRATEGY

The CNO's Navy ship maintenance strategy is composed of the following [Ref. 1]:

1. Definition

Ship maintenance is one of the two major components of the Navy's Ship Maintenance and Modernization Program, which defines the material condition and configuration of Navy ships. The ship maintenance program is designed to

keep ships at an adequate level of material readiness to maximize their required operational availability. The second component, the Fleet Modernization Program (FMP), is designed to update ship equipment and machinery as required to meet current and projected enemy threats and to incorporate safety, environmental, reliability/maintainability, and other improvements. Although the maintenance and modernization programs are separate, they are not independent and are closely coordinated.

The Navy ship maintenance strategy is defined as the process of identifying and utilizing maintenance assets in a predetermined manner in keeping the material condition of Navy ships at the desired level. These assets include personnel, material, facilities, programs, and procedures. While the specific maintenance plan is likely to differ among ship classes, the overall goal is the same.

Navy ships are different in that the responsibility for both the operation and maintenance of each ship rests with the ship itself. Other Navy organizations exist to support them. There are several different programs and procedures described in this thesis designed to support the overall maintenance strategy in preserving the ship's material condition.

2. **Strategy**

The elements of the CNO's maintenance strategy include:

a. Use of Class Maintenance Plans (CMP) developed to support the operational plan for use of each class. The objective is to tailor individual Class Maintenance Plans to best fit the opera tional cycles of that class. Class Maintenance Plans are structured with the objective of maximizing operational availability and minimiz- ing the cost of maintenance for the required material condition.

b. Use of engineered maintenance requirements performed at the lowest level of maintenance where the capability resides.

c. Integration of the support provided by the organizational, intermediate and depot levels of maintenance discussed in the next section into a coordinated system of maintenance support throughout a ship's life cycle.

d. Provision of effective Integrated Logistics Support (ILS) for including spares, technical documentation (manuals and drawings) and train ing.

e. Class Warfighting Improvement Plans which project the upgraded characteristics of the class during the class' lifetime and emphasize the grouping of ship alterations to be accomplished as a block.

f. Control of ship configuration through a formal change process which provides for updating of the central data base.

g. Standardization of equipment and components installed in ships to minimize logistics support costs during the life cycle.

3. **Procedures**

Class Maintenance Plans are considered by CNO to be the center of the Navy's ship maintenance strategy. The

transformation of these plans into maintenance actions require procedures for the assessment of equipment conditions, determination of maintenance requirements and execution of maintenance actions as described below:

a. Assessment of Equipment Condition

A thorough knowledge and assessment of actual equipment condition in relation to its designed condition is the basis for maintenance decisions. Equipment condition refers to static parameters, such as size and shape, and dynamic parameters, such as speed, temperature, pressure, voltage, etc. While ship's force is in the best position to know the condition of its ship and equipment, specialized assistance is often needed to determine the condition of much of the equipment. Such assistance is provided by several organizations within the Fleet and Systems Commands and is used as necessary to ensure a comprehensive status of equipment condition is available at all times.

Programs and organizations that are available for use in assessing equipment condition include:

Ship's Force Self Assessment
Current Ship Maintenance Project (CSMP)
Machinery Condition Assessment (MCA)
Test and Monitoring Systems (TAMS)
Pre-Overhaul Test and Inspection (POT&I)
Work Definition Inspection (WDI)
Planned Maintenance Systems (PMS)
Fleet Inspections
Board of Inspection and Survey (INSURV)
Machinery History and Trend Analysis
Total Ship Test Program (TSTP)
Assessment of Equipment Condition (AEC)

The CSMP is the primary document concerning the material condition of the ship and must be maintained in a complete and current status at all times.

*b. **Determination of Maintenance Requirements***

Based on knowledge of the material condition of the ship and equipment, the FLTCINC or his designated representatives determines the maintenance actions required to maintain or restore the equipment to its intended condition, in accordance with technical requirements defined by the systems command and using reliability-centered maintenance principles.

The complexities of shipboard equipment have led to development of support organizations, programs and procedures, including:

Class Maintenance Plans
Naval Ships' Technical Manual (NSTM)
Equipment Technical Manuals
Planning and Estimating for Repair and Alterations (PERA)
In-Service Engineering Agent (ISEA)
Direct Fleet Support (DFS)
Fleet maintenance personnel
Integrated Logistics Overhaul (ILO)
Integrated Logistic Review (ILR)
Ship Equipment Configuration Accounting System (SECAS)

Direct Fleet Support (DFS) is NAVSEA-funded engineering and technical services which are beyond that available at fleet activities. It consists of support provided to the Fleet for correcting operational and maintenance problems which are beyond the capability of ship's

force, IMAs, SRFs, or Mobile Technical Units (MOTUs). This support includes advice, instruction, and training of fleet personnel in the operation and maintenance of equipment; and reviews, tests, and inspections to evaluate the effectiveness and material condition of ships equipment and systems. The primary objective of DFS is to provide technical assistance and to promote maintenance self-sufficiency through instruction and guidance to ships forces. Some of the major DFS programs are:

(a) Naval Engineering Technical Services from NAVSEACENs and other NAVSEA engineering activities

(b) Contractor Engineering Technical Services (CETS) from NAVSEA

(c) Fleet Engineering Technical Services (FETS) from NAVELEXCENs and other COMSPAWARSYSCOM engineering activities.

A secondary objective of DFS is to provide training to ship's force in the operation and maintenance of their equipment and also to intermediate maintenance activities that provide maintenance support to the ship.

Mobile Technical Units are fleet controlled support units located at areas of major fleet concentration. The mission of the MOTUs is to improve fleet combat system readiness by elevating the technical self-sufficiency of organizational level personnel, primarily through on-the-job training in the maintenance and operation of combat system equipment. MOTU training is most often in the form of on-

board technical assistance with the correction of technical problems beyond the capability of ship's force, but also includes reviews, tests, or trials of system performance. MOTUs are manned primarily by senior enlisted personnel with technical skills and the ability to train shipboard personnel.

*c. **Execution of maintenance actions***

It is CNO policy that maintenance programs be executed with priority placed on providing ships that can reliably perform their missions. Three levels of maintenance are defined, to provide for accomplishment at increasing levels of skill and facility assets. These three levels are explained in the next section. The specific maintenance programs combine the various evaluation and planning assets previously discussed as best suited to the ship's operational requirements.

*d. **Surface ship maintenance challenge***

The current challenge faced by today's maintenance resource manager involves rethinking the issue of ship's maintenance requirements in view of current and projected reductions in maintenance funding. A recent article entitled "*The Surface Ship Maintenance Challenge*" [Ref. 3] outlines the evolution of surface ship maintenance funding environment and traces the attitudes and philosophies concerning shipboard material condition from

the austerity of the 1940's and 1950's, where ship's force were much more self-reliant, through improvements in the 1960's with the introduction of the Engineer Officers School, Planned Maintenance System (PMS), and the integration of repair and modernization through Planning and Engineering for Repairs and Alterations (PERA) organization.

The 1970's brought major transitions in the maintenance management structure with the merger of the three type commanders to one surface force commander and the merger of Naval Ship Systems Command and Naval Ordnance Systems Command into Naval Sea Systems Command. In the mid-70's the Destroyer Engineered Operating Cycle (DDEOC) maintenance strategy was introduced, as was NAVSEA's Maintenance System Development Program which instituted the concept of reliability-centered maintenance (RCM). During the Reagan Era of the 1980's and the boost in defense spending came a rash of construction and modernization for (1) shore intermediate maintenance activities, (2) time-directed equipment change-out requirements for Engineering Operating Cycle (EOC) and Progressive Maintenance ships, (3) longer and costlier ship overhauls, and (4) increased pressure to assign overhauls to the private sector.

Then, in 1984 the under secretary of the Navy commissioned a Navy Industrial Fund (NIF) study to examine potential opportunities for ship repair cost savings. In response to increased pressure to reduce fleet maintenance

funding, NAVSEA initiated several programs during this time: (1) System and Equipment Maintenance Monitoring for Surface Ships (SEMMSS) Program to permit extended overhaul interval durations (SEMMSS recently became the Assessment of Equipment Monitoring (AEC) program), (2) reorganizing the Industrial and Facilities Management to strengthen the naval shipyard organization, (3) establishing the Surface Ship Maintenance Office (SSMO) for surface ship maintenance coordination, and (4) consolidating the responsibility for the Fleet Modernization Program (FMP) budget preparation into one code. [Ref. 3].

Jacobs and Smith point out that in the past ship's force have played a major role in the upkeep and maintenance of their ship's with much more repair work being accomplished on the organizational vice depot level. The potential for further increased involvement in maintenance action by ship's force is identified. Also, NAVSEA is seen as a partner with the type commander in meeting the new maintenance challenge by committing its engineering and technology in cooperation with the type commander's experience and shipboard knowledge to identify and select the "most effective maintenance decisions". [Ref. 3].

D. LEVELS OF MAINTENANCE

As previously stated, it is Navy policy that ship maintenance and modernization work be performed at the

lowest effective level throughout the life cycle of the ships [Ref. 1]. The Ship Maintenance and Modernization Program implements this policy. This is a balanced program that requires contributions from each of the three levels of maintenance within the Navy. Each of the three levels requires a greater degree of capability. Organization level maintenance and intermediate level maintenance are within the capability of the FLTCINC and are his responsibility. The greatest industrial capacity resides within the depot level, comprised of Naval and private shipyards, ship repair facilities, and assigned DoD or commercial Designated Overhaul Points (DOPs).

1. **Organizational Level Maintenance**

The lowest level of maintenance is the organizational level (O-level) consisting of the ship itself and the sailors on board the ship. Organization level maintenance is any corrective and preventive maintenance accomplished by the ship's crew. The work consists of equipment operation, condition monitoring, planned maintenance actions and repair. The ship's personnel are both the operators and maintainers of their equipment.

The individual ship is tasked with being maintenance self-sufficient to the degree achievable within manpower and facility constraints. The Planned Maintenance System (PMS) described in the Maintenance and Material Management (3-M)

Manual [Ref. 4] defines the minimum scheduled preventive maintenance program to be carried out aboard an individual ship. When PMS is not available, existing technical manuals and instructions issued by cognizant systems commands are applicable.

2. **Intermediate Level Maintenance**

The second level of maintenance is the Intermediate level (I-level) consisting of Tenders, Repair Ships, Shore Intermediate Maintenance Activities (SIMAs) and Naval Reserve Maintenance Facilities (SIMA NRMFs), where Navy personnel with specialized facilities and training accomplish intermediate level repair work.

SIMAs and SIMA NRMFs report directly to the Readiness Support Groups (RSGs). Additionally, the RSGs assign area maintenance work to all the tenders. It is the role of the RSGs to coordinate all area depot and intermediate maintenance and repair requirements (except for ROH/SRA). They also coordinate all waterfront maintenance related events and technical assists. The Commanding Officers (COs) of the RSGs report directly to their type commander. COs of RSGs liaison directly with group and squadron commanders and individual ships whenever necessary to expedite repair and ensure coordination. The functions and services provided by the RSGs as follows: (1) Serve as area coordinator for all IMA repair requirements, (2)

Provide short range IMA availability scheduling, (3) Screen all work requests for IMA availabilities, (4) Screen all work requests for unscheduled intermediate or depot level maintenance that are emergent, (5) Assign and prioritize work schedules for work assigned to tenders and SIMAs, (6) assess and allocate IMA work loading (assignments) to ensure equitable and efficient distribution of work, (7) act as type commander representative for work progressing as necessary, (8) coordinate all requests for technical assistance, (9) coordinate and conduct IMAV work definition conferences, (10) promulgate monthly dive schedule, and (11) coordinate weekend and after-hour planned and emergent work. [Refs. 5 and 8].

Intermediate level maintenance normally consists of calibration, repair or replacement of unserviceable parts, and providing technical assistance.

Intermediate level maintenance activities use the 3-M System to develop and process the maintenance actions for IMA upkeep periods including early identification and assignment of work items.

Intermediate Maintenance Activities accomplish ship maintenance beyond a ship's force capability or capacity to the maximum extent possible consistent with the availability of material, funds and skilled manpower.

3. Depot Level Maintenance

Depot level maintenance is that type of maintenance generally requiring a greater industrial capability than possessed by either organizational or intermediate activities. It consists of that maintenance performed by shipyards, either private or Navy, Naval Ship Repair Facilities, or other shore based activities on equipment requiring major overhaul or complete rebuild of parts, assemblies, subassemblies, end items, and complete platforms, including manufacture of parts.

The only work scheduled for accomplishment by depot level maintenance activities is that which, in the judgment of the Type Commander Representative, COMNAVSEASYSCOM, or COMSPAWARSYSCOM in their specific areas of responsibility, cannot be accomplished by organizational or intermediate level maintenance activities, or where split responsibility between fleet and depot maintenance activities should be avoided.

E. INDUSTRIAL AVAILABILITIES

1. Availability Types.

The information in this section was obtained from references 1, 5 and 8.

a. Regular Overhaul (ROH).

An ROH is an availability for the accomplishment of general repairs and alterations at a naval shipyard, private shipyard, or other shore based repair activity.

*b. **Complex Overhaul (COH).***

A COH is an overhaul that, because of funds, time, or manpower constraints, or the complexity or interrelationship of the various ship subsystems affected by the overhaul work packages, requires extraordinary coordination and extensive management of the planning and industrial phases of the overhaul in order to produce a high level of confidence that the overhaul will be satisfactorily completed. All CV, LHV, AGF, and nuclear powered surface ship overhauls are, by definition, complex overhauls.

*c. **Baseline Overhaul (BOH).***

A BOH is an overhaul that is designed to restore a ship's systems, subsystems and equipment to a baseline condition before the ship is placed on an engineering operating cycle. The intent of the BOH is to provide an extensive overhaul that, together with a well engineered and executed maintenance program, will enable the ship to carry out its mission throughout an extended operating cycle.

*d. **Selected Restricted Availability (SRA).***

A SRA is an availability for the accomplishment of repairs and selected alterations by depot activities,

frequently with intermediate level maintenance. These availabilities are assigned to accomplish work that is required to sustain the material condition of the ship between overhauls, particularly those ships that are on extended operating cycles. SRAs are utilized to accomplish required depot level maintenance of ships on progressive overhaul strategies. SRAs are short, labor intensive availabilities that are generally scheduled at specific times throughout the operating cycle. They are scheduled sufficiently in advance to ensure advanced planning time and funds are effectively utilized.

e. Docking Selected Restricted Availability (DSRA).

A DSRA ia a SRA extended to include drydocking of the ship.

f. Phased Maintenance Availability (PMA).

A PMA is a short, labor intensive availability for the accomplishment of general repairs and alterations by depot level maintenance activities. Ships assigned to Phased Maintenance Programs are maintained through PMAs in lieu of ROHs.

g. Docking Phased Maintenance Availability (DPMA).

A DPMA is a PMA extended to include the drydocking of the ship.

h. Restricted Availability (RAV).

An RAV is an availability assigned for the accomplishment of specific items of work by a industrial activity with the ship present.

i. Tecnical Availability (TAV).

A TAV is an availability for the accomplishment of specific items of work by a repair activity, normally with the ship not present, during which time the ship's ability to fully perform its assigned mission and tasks is not affected.

j. Voyage Repair (VR).

A VR is emergency work necessary to enable a ship to continue on its mission and which can be accomplished without requiring a change in the ship's operating schedule or general steaming notice in effect.

k. Fitting Out Availability (FOA).

A FOA ia an availability at the shipyard to place on board the material specified in the ship's allowance lists.

l. Post Shakedown Availability (PSA).

A PSA is an availability assigned to newly built, activated or converted ships upon completion of shakedown. The PSA is normally between one-and-one half to four months duration and must be completed not later than the end of the eleventh month after completion of the fitting out. Work

performed normally includes correction of deficiencies noted during the shakedown, correction of deficiencies remaining from the acceptance trials, and performance of class modifications remaining from the new construction period.

m. Service Life Extension Program (SLEP).

The SLEP is a depot level program to extend the service life of a ship beyond that which it was initially designed. Following SLEP these ships are maintained and modernized through normal overhaul procedures.

2. **Availability Assignment.**

COMNAVSEASYSCOM assigns and schedules overhauls, SRAs, and PMAs. OP-32 promulgates the notional durations, notional intervals, and approved schedules for depot availabilities by OPNAV notice. Approved schedules are maintained in a CNO data base which is used in producing NAVSEANOTE 4710 (Pacific and Atlantic Depot Maintenance Schedule) [Ref. 9]. The CNO schedule data base is also the source of the schedule information that appears in the Fleet Modernization Program Management Information System (FMPMIS).

The FLTCINC or his designated representative will assign and schedule RAVs, TAVs, and VRs.

3. **Availability Scheduling.**

a. Overhaul Scheduling

Ships generally undergo overhauls at the intervals and durations set forth in the current OPNAVNOTE 4700. Some minor deviation to the overhaul intervals are accommodated to ensure compatibility with the employment schedule of each ship. Major deviation from overhaul intervals must be fully justified and approved by the type and fleet commanders and approved by CNO. The overhaul durations specified in OPNAVNOTE 4700 [Ref. 2] are to be used as nominal overhaul durations in long range planning and at the annual Fleet Depot Maintenance Scheduling Conferences. After the scope of the work package is known from the Work Definition Conference (WDC), it is incumbent upon the overhauling activity commander to evaluate the work package and assess his capability and ability to perform the work in the allotted time. Any recommended adjustments in duration must be officially addressed as soon as possible after the WDC.

b. SRA and PMA Scheduling.

Ships generally undergo SRAs and PMAs in accordance with the criteria established in the current OPNAVNOTE 4700. Durations should not require adjustment to accommodate the size of the repair package; however, it may be necessary to increase durations to accommodate urgent

alterations that are essential to improving the mission capability of the ship or to accomplish necessary repairs.

c. Criteria for Assignment to Industrial Activity.

Assignment of an availability to a specific ship in a Naval shipyard or under SUPSHIPS is based on material readiness requirements and technical considerations as well as the following guidelines [Ref. 2]:

(1) Naval shipyards are the nation's principal asset for depot level overhaul of nuclear ships and complex nonnuclear surface ships and for providing the principal industrial repair capability to address battle damage in wartime and voyage repairs in peacetime.

(2) Navy Depot level availabilities awarded in the private sector are to be accomplished in a manner to assure quality performance, promote competition, support the nation's industrial base, and include quality of life considerations for the ship's force.

F. MAINTENANCE STRATEGIES

All Class Maintenance Plans (CMPs) are developed following the concepts of reliability centered maintenance (RCM). The goal of RCM is to accomplish maintenance necessary to achieve maximum operational availability at the lowest practical cost. Following this concept, a thorough knowledge and assessment of actual equipment condition in

relation to its designed condition is to be the basis for maintenance decisions. [Ref. 1]

Ship class maintenance strategies are described in the following subsections.

1. **Engineering Operating Cycle Programs (EOC).**

Engineering Operating Cycle Programs are intended to establish a structured, engineering approach for maintaining BB61, CG 16/26, CG 47 AND DD963/DDG993 classes on a 5-7 year operating cycle. The principal goal of EOC is to keep ships ready for combat while maintaining or increasing their peacetime operational availability at an acceptable cost. They anticipate intermediate and depot level maintenance and modernization requirements and plan for required resources at appropriate points in the ship's operating cycle. Engineering analyses are the basis for defining maintenance to be scheduled and performed during periods of assigned maintenance availabilities. There are a number of EOC programs in various stages of planning, development or implementation, all with common goals and similar support and interface requirements. Similarities and commonalities are capitalized upon by making use of established support organizations, plans, procedures and engineering techniques.

During the engineering operating cycle, each ship is assigned (1) an interdeployment SRA of 6-8 weeks and (2) IMAVs of 3-4 weeks between depot availabilities. A "key

window" concept allows flexibility in scheduling availabilities and work package planning. An Assessment of Equipment (AEC) for specified systems and equipment is performed by the Performance Monitoring Team (PMT). These teams periodically visit ships, usually 60-90 days before the start of an SRA and sometime following the SRA, and measure designated system and equipment condition parameters. Repair recommendations are made based upon conditions encountered during the visit or subsequent technical analysis.

The CMP for each EOC class ship identifies maintenance, maintenance frequency and repair level, and estimated manpower and logistics support for each identified task. CMPs utilize maintenance-oriented actions that, based on engineering analysis, are presumably predictable during the ships operating cycle. The two major categories of tasks included in the CMP are (1) engineered maintenance requirements and (2) qualified maintenance estimates. Typical engineered tasks include (1) class B overhauls, (2) fundamental tests and inspections, (3) PMS actions requiring outside assistance, and (4) other well-defined maintenance tasks. Qualified maintenance estimates identify corrective tasks that engineering analyses or historical data indicate will probably be required. Qualified tasks are performed as required.

2. **Progressive Ship Maintenance.**

Progressive maintenance is a strategy that supports FFG 7 and PHM class ships that are designed for reduced manning and limited organizational level maintenance and specific ships homeported in forward deployed areas with operational tempos that limit the length of intervals available for accomplishment of maintenance. Reduced manned ships are designed for component removal and replacement, with maintenance and repair being performed by intermediate and depot level activities to compensate for the reduced organizational level maintenance capability. These design concepts have required the development of maintenance and logistics support systems different from those required for other surface ships. Both the FFG 7 and the PHM 1 class ships were not designed to be supported by traditional methods and are maintained using the Progressive Ship Maintenance strategy.

The progressive approach is to conduct engineering analyses of installed equipment and systems to determine their failure rates and effects and determine what support is required. The analysis determines the preventive maintenance plan, estimates the corrective maintenance requirements, and establishes the level of repair. From these analyses, the supply requirements for rotatable pools are determined. These pools consists of replacement machinery and parts and are required to achieve quick turn-

around times necessary for the accomplishment of ajor maintenance items during the short IMAVs and SRAs, and to minimize the corrective maintenance burden at the organizational level. The progressive maintenance philosophy encompasses the following:

(1) Progressive SRAs/DSRAs.

(2) Increased use of Engineered Maintenance Planning.

(3) Increased use of modular replacement.

(4) Constraints placed on shipboard at-sea maintenance by ship's force.

(5) Upgrading of maintenance tasks from ship's force to the intermediate or depot level.

(6) Improved material support and stock level management.

(7) Reduced allowable spare parts and test equipment on PHMs due to weight limitations.

3. **Phased Maintenance Program (PMP).**

The Phased Maintenance Program is a maintenance strategy in which depot level maintenance is performed through a series of short, frequent Phased Maintenance Availabilities (PMAs) in lieu of Regular Overhauls. To the maximum extent practicable, repairs are authorized based on the actual material condition of the ship and its equipment as determined by the Port Engineer. The program also employs innovative material support procedures. The goals of PMP are maximum ship availability, improved operational

readiness, and upgraded material condition. The essential features of Phased Maintenance are as follows:

a. Operating and maintenance schedules.

Ships are scheduled for PMAs of 2 to 4 month duration at intervals of approximately 15 to 18 months. One PMA in the cycle is extended by one month to included dry-docking. Both repair and modernization are included in the PMA. Total depot level manday allocations are specified for the cycle.

b. Condition-Directed Repair.

The main determinant of repair is the actual material condition of systems and equipment. Only those repairs necessary to sustain proper functioning of equipment are identified and authorized for accomplishment.

c. Port Engineers.

The port engineer has broad experience in ship maintenance and repair and is assigned to the Type Commander staff for intensive maintenance management of assigned ships. The port engineer remains with the same ships through their cycle, and is involved in planning, budgeting, authorizing and execution of all maintenance actions. The role of the port engineer in work package development is addressed in Section H of Chapter III.

The next chapter provides the background on maintenance and repair work definition process and work package development.

III. OVERVIEW OF WORK DEFINITION PROCESS

There are numerous components of work definition and the work definition process. The foundations for work definition and how, once defined, a work package is created, are described below. Additionally, this chapter outlines the maintenance management tools used in defining the ship's work package and the role of PERA, the Port Engineer and SUPSHIP in work package planning and preparation.

A. THE 3-M PROGRAM

The Maintenance and Material Management Program (3-M Program) is the primary maintenance management program as per OPNAVINST 4709.4B [Ref. 4]. Equipment not covered by Planned Maintenance System (PMS) component of 3-M is maintained in accordance with applicable technical directives. PMS has been designed as a management tool for shipboard managers and supervisors to assist in planning, scheduling and assigning to qualified personnel the various maintenance tasks required. The Maintenance Data System (MDS) is a maintenance and material control information system and is used to report any outstanding material discrepancies, all corrective maintenance, failed part reporting on selected equipment, and general maintenance information considered significant.[Ref. 4]. An effective

3-M program helps create an up-to-date Current Ship's Maintenance Program (CSMP), which is the ship's force generated repository for all maintenance requirements.

B. MAINTENANCE MANAGEMENT AIDS

1. Current Ship's Maintenance Project (CSMP).

The most important maintenance management aid used by ship's force is the Current Ship's Maintenance Project (CSMP). The automated CSMP, created by ship's force, provides the ship, Type Commander and other activities a means to determine (a) the effect of deferred maintenance in limiting the ship's capabilities, (b) maintenance problems and trends, (c) future maintenance funding requirements, and (d) scheduling of availabilities. It also provides a basis for planning repair actions in support of individual ships such as long lead time design or material acquisition. Additionally, since the CSMP classifies jobs by department, division and individual work centers within the divisions, the CSMP also assists in assessing the material condition of each individual work center aboard ship.

The CSMP should always reflect actual material condition of the ship and should be used as the primary maintenance management tool [Ref. 3]. It should contain items for all repair actions required to bring the material condition of the ship to the highest possible state of material readiness. Approved alterations, INSURV

deficiencies, habitability improvements, and certain deferred PMS actions must be entered into the CSMP. All maintenance actions requiring outside assistance must be similarly recorded.

One beneficial aspect of an up-to-date and correct CSMP data listing is the automatic computer printout of 4790/2Q Automated Work Requests (AWRs) which are extremely useful planning tools for an overhaul or other maintenance availability. If the CSMP truly presents the condition and repair requirements of the ship, recording additional maintenance requirements is eliminated and work requests are produced automatically. AWR's can be generated from the CSMP selectively by availability type and priority, or specific items by work center and job sequence number (JSN). With current and accurate information, repairs can be better planned and budgeted.

An accurate and up-to-date CSMP is considered by OPNAV to be the key to the Continuous Maintenance Strategy [Ref. 1]. This strategy uses the pre-screened CSMP to help fully load the IMA's. Additionally, this strategy allows the ordering of long lead time material regardless of which IMA actually accomplishes the work.

The Maintenance Resource Management System (MRMS) provides the means for all shipboard ADP systems to interface by magnetic media (floppy disk or magnetic tape). This magnetic transfer, coupled with radio transmission by

shipboard maintenance action form (SMAF), essentially eliminates the necessity for paper transfer of 4790/2K forms. It is the responsibility of all automated units to ensure that the shore version of the CSMP, as maintained in MRMS, is consistent with the afloat version.

2. **Master Job Catalog.**

The Master Job Catalog consists of standard repairs accomplished on a repetitive basis. This system allows work center supervisors to request master jobs to be accomplished for his work center during an availability. Manuals, also referred to as master job catalog indexes, are provided to shipboard personnel as a user's guide to the MJC.

By using the information contained in the MJC, ships select master jobs for inclusion in their CSMP through the data processing center. This eliminates the need to submit an OPNAV 4790/2K form for these jobs. The MJC computer program also features an "AUTO CLOSE" of all MJC items at the end of an IMA availability, closing out all accomplished jobs. MJC indexes are used when available.

3. **Fleet Management System- Real Time (FMS-RT).**

FMS-RT is a system developed by NAVSEA to provide a less complicated means for planning and monitoring ship's force work during availabilities. It is Shipboard Non-tactical ADP Program (SNAP II) compatible and can reside entirely within the ship.

4. Ship Alteration and Repair Package (SARP).

The Current Ships Maintenance Project (CSMP) tape contains the principal data used to produce the SARP. The SARP defines total work to be authorized for accomplishment by industrial activities and ship's force during selected restricted availabilities or overhauls. The SARP is developed by PERA prior to the availability and draws on various elements for input. Although the CSMP computer tape is the primary input element, other input elements include standard items and alterations. As a result of TYCOM screening, the SARP is divided into an industrial activity work package, an IMA work package and ship's force work package. A detailed description of SARP is contained in Section F of this chapter.

C. MAINTENANCE RESOURCE MANAGEMENT SYSTEM

1. Maintenance Resource Management System (MRMS)

MRMS was developed to support the management of waterfront maintenance by allowing more effective management of maintenance assets and improving the response to ship originated maintenance deferrals. The ongoing development of MRMS remains consistent with long-term Ship's Non-tactical Automated Data Processing System (SNAP I,II), Type Commander's Headquarters Automated Information System (THAIS), and Intermediate Maintenance Activity Maintenance Management System-Real Time (IMMS-RT). MRMS interfaces with

a number of data processing systems which link the Navy's historical data files, shipboard maintenance projects, and both intermediate and depot-level repair facilities. MRMS also serves as a CSMP holder ashore for automated ships and maintains primary automated CSMP files for non-automated ships assigned to the system.

MRMS is the TYCOM computer-aided method of maintaining the force-wide CSMP. TYCOM maintenance representatives are able to receive work requests from ships, update CSMP files, establish availability files, call down jobs to the file and screen/assign jobs to repair activities within 48-96 hours from time of transmission. MRMS is designed to provide the following services to system users [Ref 4]:

a. Generate individual or bulk automated work requests (AWR's).

b. Produce CSMP 1B summary hard copy report or Naval message tape.

c. Produce CSMP Report 2 (full narrative); CSMP Report 1C for the Board of Inspection and Survey (INSURV); CSMP Report 1D (safety summary).

d. Transfer CSMP data via AUTODIN, modem, 9-track magnetic tapes, or floppy disk.

e. Load standard Maintenance Data System (MDS) data.

f. Produce Casualty Report (CASREP) summaries from daily inputs.

g. Produce Type Commander Work Package Tracking (TWPT) reports.

h. Update MDS files at Navy Maintenance Support Offices (NAMSO).

i. Produce complete package or multipart OPNAV 4790/2Q reports for each unit, as requested, immediately prior to INSURV inspection.

j. Load Master Job Catalog (MJC) work items to a specific CSMP for non-automated units.

k. Accept paper tape input of maintenance actions.

l. Load standard MDS data from communication station produced tapes containing consolidated Ship Maintenance Action Form (SMAF) inputs.

m. Accept calldown message tapes and automatically transfer JSN's from CSMP to an availability file.

n. Load INSURV, Pre-Overhaul Test and Inspection (POT&I) and Repair Maintenance Management system Class Maintenance Plan (RMMS CMP) items to individual CSMP accounts via RMMS or Naval message tapes for non-automated units.

o. Screen, review and modify deferrals on line for non-automated ships.

p. Screen incoming data for critical data elements and errors, and produce error summary reports.

q. Supports the Continuous Maintenance strategy

2. **Other ADP Programs.**

a. Type Commander Headquarters Automated Information System (THAIS).

THAIS provides ADP support to the Type Commander staffs in ten functional areas: Aviation Maintenance, Ship Maintenance, Logistics, Administration, Readiness, Employment, Personnel, Inspections, and Command Index. Type Commander Maintenance Module (TMMM) is the ship maintenance

module of THAIS. The design of TMMM is to provide information pertinent to ship maintenance resource allocation. The goal is to maximize use of available resources and perform work in order of priority [Ref. 5]. The system allows maintenance scheduling, material readiness evaluation and administration.

b. IMA Maintenance Management System-Real Time (IMMS-RT).

The IMMS-RT system is designed for afloat IMA's, providing a real time, on line, interactive system in work package screening, work package planning, and work package management.

c. Shipboard Non-tactical ADP Program (SNAP).

SNAP was originally designed to provide improved data processing support to afloat units in the areas of supply and maintenance. Programs now include other significant functional areas such as administration, pay, personnel, training, medical, and dental.

d. Waterfront Maintenance Management System Network (WMMSNET).

WMMSNET was developed to provide maintenance management and data processing capabilities for non-automated ships. WMMSNET provides the capability to maintain CSMP files and update backup CSMP at MRMS sites via floppy disks.

D. CSMP DATA INPUT

1. Non-Automated Ships.

Non-automated ships maintain their CSMP on the MRMS data base. Paper tape updates are still accepted. The work center work list (WCWL) is maintained separately onboard the ship in handwritten form. OPNAV form 4790/2K is no longer used.

2. Automated Ships.

SNAP and WMMSNET equipped ships maintain their own CSMP but must also maintain a back-up automated CSMP, updated bi-weekly on the MRMS data base by submission of a magnetic tape or a floppy disk.

3. Magnetic Tape Input.

Magnetic tape input is the primary source of data for MRMS. Magnetic tapes containing SMAF data are received daily from Naval Telecommunications Commands and delivered to MRMS site for processing. Tapes are also exchanged with PEPA, INSURV, NAMSO, NARDAC, tenders and SNAP-equipped ships. SNAP equipped ships must submit updates bi-weekly and as necessary to ensure MRMS provides an accurate CSMP data base.

4. Ships Maintenance Action Form (SMAF).

Message input by SMAF has reduced the time delay for deferral assignment from 45 days to approximately 48 to 72 hours. Error listings are produced at the same time to

identify maintenance transactions not successfully transferred to data files.

5. **Inter-System Procedures.**

The data base is accessible except when hardware is secured for maintenance or backup creation. Electronic mail functions are available to staff users. Any person assigned a "mail address" may send or receive messages in the system. Mail provides one method of communication between system operators.

6. **Intra-System Procedures.**

a. INSURV.

Following INSURV inspection, AWR's are updated, augmented, and re-entered to INSURV computer database. During post-INSURV processing, updated INSURV data is returned and re-entered in MRMS or the ship CSMP file from magnetic tape.

b. PERA SURFACE.

The Engineering Operating Cycle (EOC) is supported by a Class Maintenance Plan (CMP) for each class of ship in the EOC. Selected information from the CMP is maintained on a data base by PERA and can be merged with the MRMS data base.

c. NAVSEA.

NAVSEA generated maintenance requirements including SHIPALTS, ORDALTS and MACHALTS are merged with the

MPMS data base. NAVSEA maintenance requirements are assigned to special administrative work centers when merged with the unit's CSMP.

E. MAINTENANCE AVAILABILITY PLANNING TOOLS

The following is a listing and description of some of the many instruments available to the Commanding Officer, department heads, division officers and work center supervisors aboard ship to be used for effective organization and management of maintenance related activities. These tools are designed to result in a higher level of equipment and system reliability and improved productivity.

1. Maintenance Data System (MDS).

MDS is the basic system for maintenance and repair planning and documentation. The following parts are essential to repair planning:

a. Current Ship's Maintenance Project (CSMP).

The CSMP is the basis of the Ship Alteration and Repair Package (SARP). Automated Work Requests (AWRs) are used to describe work requiring outside assistance. The CSMP should be current at all times. It is especially important that the CSMP be complete and current at the start of availability planning.

b. Planned Maintenance System (PMS).

Many of the tests and inspections conducted to further define repair requirements are based on PMS standards. The ship's work load can be reduced and repair planning improved when repair requirements are coordinated with routine and PMS scheduling.

c. Master Job Catalog (MJC) and Standard Work Request Items.

The MJC and standard work requests are a listing of recurring repairs that may be included in an upcoming availability. Many of these repair items are included in the MJC and class maintenance plans (CMP's). For some ships in Phased Maintenance, PERA calls down the applicable MJC items and includes them in the work package. Individual repair requests must be prepared for any required standard repairs that are not in the MJC or CMP.

d. Zone Inspections.

Careful scheduling and documentation of zone inspections can also reduce ship's force test and inspection workload and enhance work package development.

2. **Standard Repair/Overhaul Classes.**

Work requests or job orders frequently contain requirements using terms such as "class B overhaul" or "class C repairs ". These terms are often misused and the scope of work to be performed misunderstood. According to

the CNSP Maintenance Manual [Ref. 5], correct definitions are:

a. Class A.

Work requiring overhaul or repairs, modifications, field changes, ORDALT's or SHIPALT's to sustain or improve the operating and performance characteristics of the system, subsystem, or component being repaired or altered to meet the most recent design and technical specifications for that item are defined as class A. It is intended that the end product be like new in appearance, operation and performance. All manufacturer's and technical manual/documentation performance standards and specifications must be met. The repair activity will demonstrate that the end product successfully meets all performance criteria specified. Defining a class A repair means that all actions required to meet definitions are authorized. This definition applies to all components, subsystems, and systems whether machinery, electronics, or weapons.

b. Class B.

Work requiring overhaul or repairs to restore the operation and performance of a system, subsystem or component to original design and technical specifications is defined as class B. If the requirement is to restore the operating and performance characteristics of an item to

other than original design and technical specifications, this must be specified and the performance criteria defined. Ship alterations (SHIPALT's), ordnance alterations (ORDALT's), field changes, and modifications are not accomplished unless specified by the customer. Maintenance, adjustment, and calibration routines specified by the applicable instruction manual are required. The repair activity will demonstrate that the end product meets all performance criteria in the specifications.

c. Class C.

Repair work on a system, subsystem or component specified by work request, or work required to correct particular deficiencies or malfunctions specified by the customer is called class C. The repair activity must demonstrate that the work requested has been accomplished or that conditions or malfunctions described have been corrected. The repairing activity has no responsibility for repair or proper operation of associated components of the equipment or for operation of the system as a whole.

d. Class D.

Class D work is defined as work associated with Open, Inspect, and Report work requests in which the customer cannot specifically identify the problem. This class of work is intended to be diagnostic and may require various tests, followed by inspection to assist in a

complete diagnosis. The repair activity will report findings, recommendations and costs estimates to the customer for authorization prior to any repair work. When requested by the customer, minor repairs and adjustments, to the extent specified, may be accomplished without prior approval.

e. Class E.

Class E work is defined as work required to incorporate all alterations and modifications specified for a designated system, or component. The repair activity will demonstrate the successful check-out of the work accomplished to assure compliance with performance standards established for the modification only to the extent of the work performed. When required by the customer, the repair activity will conduct system tests to prove system operability through affected interfaces. Repairs, if any, will be minor.

3. **Standard Work Items.**

Standard work items and repair standards have been established by NAVSEA to improve the quality and methods of work performed in repairing or overhauling various equipment. Under this system most routine repairs will be covered.

a. NAVSEA Standard Work Items.

NAVSEA Standard Work Items (SWI) establish a Navy-wide standard for methods and quality control measures used in disassembly, inspection, repair, reassembly, and testing of equipment covered by SWI's. SWI's are developed for private sector availabilities. The intent is to reduce the rate of equipment failure and subsequent rework, improve repair work confidence, and reduce administrative burdens.

b. Technical Repair Standards (TRS).

Technical repair standards are similar to SWIs but apply to Naval shipyards and repair activities.

c. Reliability Centered Maintenance Influence on Use of Standard Work Items.

NAVSEA SWI and TRS are written to include all elements of work required for complete class B overhaul. Reliability centered maintenance (RCM) philosophies now being incorporated into all class maintenance plans stipulate that only repairs required for satisfactory equipment operation be performed.

d. Quality Assurance (QA).

No maintenance work and planning efforts are complete if QA is lacking. Although all Naval repair activities and private shipyards maintain a QA program, the ultimate responsibility for QA rests with the ship, and particularly with the work center supervisor and division

officer responsible for the repaired equipment. [Ref. 5 and 8].

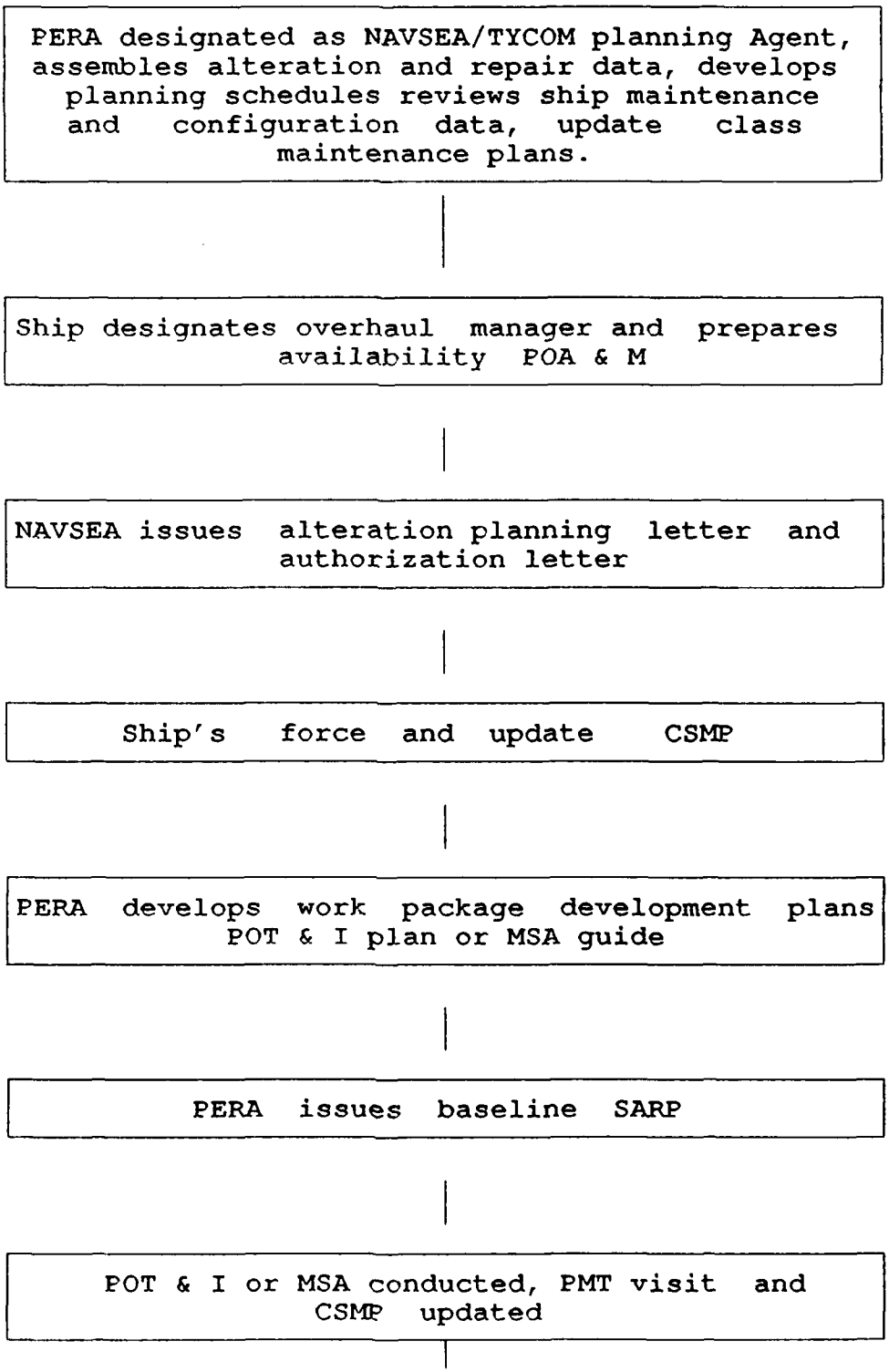
F. SURFACE SHIP AVAILABILITY PLANNING PROCESS

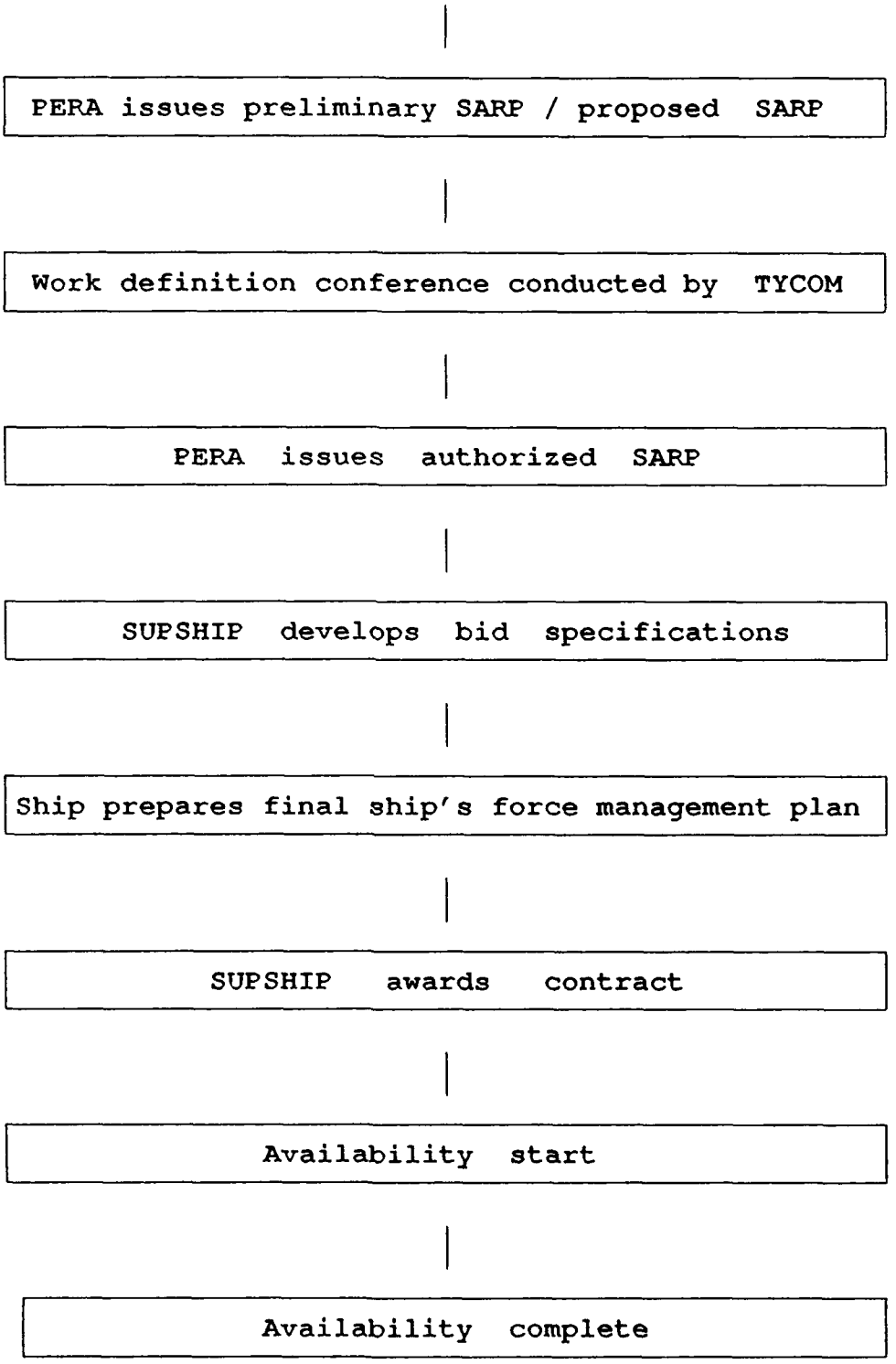
The availability planning process is influenced greatly by SHIPALT design and material procurement lead times and by the ship's operating schedule. Phased maintenance programs extend the life cycle maintenance periods by inserting restricted availabilities into the operating cycle. The work packages for these availabilities, although of lesser scope than a ROH, include both SHIPALT's and repairs. The time available for phased maintenance planning is considerably less than ROH planning because of the reduced scope of work. Phased maintenance planning is also influenced by the use of class maintenance plans and the assignment of a port engineer to oversee repair planning. Additionally, the ship's operating schedule has a greater impact on phased maintenance availability than on ROH planning. Shipboard repair planning procedures are essentially the same for both shipyard and IMA availabilities. Availability planning can be broken down into four basic overlapping elements:

Preliminary Preparations
Alteration Planning
Work Package Development
Work Authorization

All elements are involved in planning a shipyard availability but IMA availabilities do not involve large or significant alteration packages.

AVAILABILITY PLANNING PROCESS




PERA issues preliminary SARP / proposed SARP
Work definition conference conducted by TYCOM
PERA issues authorized SARP
SUPSHIP develops bid specifications
Ship prepares final ship's force management plan
SUPSHIP awards contract
Availability start
Availability complete

1. Preliminary Preparations.

a. Planning Engineering Repairs and Alterations (PERA).

PERA may be tasked to assist NAVSEA and TYCOM for alteration and repair advance planning. At the start of the planning cycle, PERA assembles pertinent alteration and repair data and develops a planning schedule. PERA may assist the type commander by briefing the ship on availability planning in general and reviewing the planning schedule and requirements for that particular availability. PERA assembles and reviews ship maintenance and configuration data to update class files. PERA also prepares and updates the class maintenance plans. The role of PERA is described in greater detail in section G of this chapter.

b. Overhaul Manager.

The ship must designate an overhaul manager. Ideally, the ship's overhaul manager should have prior overhaul experience and should be aboard through the entire availability and is typically an officer in the engineering department.

c. Plan of Action and Milestones (POA&M).

The ship is required to prepare a POA&M to establish a schedule for all major evolutions such as CSMP update, design and repair shipchecks, work package

determination tests and inspections, work definition conference and submission of supplemental work. The plan is be built around the deployment schedule of the ship and includes all related availabilities. Training and NAVEDTRA off-ship school requirements must also be included in the plan. Since all of this information will not be known 12-18 months in advance, the POA&M is reviewed and updated periodically to reflect changes and additional requirements as they become known.

2. **Alteration Planning.**

a. The Fleet Modernization Program (FMP).

FMP governs the alteration planning schedule. It dictates alteration funding, material procurement and installation schedules. NAVSEA, as CNO's agent, controls Title K SHIPALT's and ORDALT planning. TYCOM's control Title D and F SHIPALT scheduling with design support from NAVSEA. TYCOM also controls AER scheduling.

b. Alteration Planning Letter.

NAVSEA issues an alteration planning letter listing the Title K SHIPALT's and major ORDALT's planned for the availability early in the availability planning process. The letter provides advance notice to affected organizations and authorization to proceed with alteration design and material procurement only. The letter also will list any special program material (SPM) required for the alterations.

The TYCOM also issues a letter early in the planning process, addressing Title D and F SHIPALT and AER programming. Based on these letters and related funding documents, the design and material procurement agent starts his work.

During the availability planning process, NAVSEA will conduct on board design verifications (shipchecks). These shipcheck are conducted early in the planning cycle to allow for the development of SHIPALT installation drawings needed for the availability. If SID's have been previously developed, they will be checked against the ship to determine if they are suitable or if additional drawings will be required.

c. ***Alteration Authorization Letter.***

Approximately one year before the scheduled start of the availability, NAVSEA issues an alteration authorization letter. This letter supersedes the earlier planning letter and lists Title K SHIPALT's and major ORDALT's authorized for accomplishment during the availability. It may include Title D and F SHIPALT's and AER's authorized by the type commander. Special program material and the responsible procurement agents are listed. The purpose of this letter is to provide early cancellation of those alterations for which drawings or materials will not be on hand in time for the availability. The ship must

review each listed alteration in detail to verify that it is applicable, that it has not been fully or partially accomplished and that all machinery or equipment listed in the alteration record as being onboard is actually on board. NAVSEA should be notified of any discrepancies, and copies of the letter (or message) should be sent to the type commander and ISIC. Alteration drawing and material availability is reviewed in conjunction with the Work Definition Conference (WDC).

3. **Work Package Development (WPD)**

a. Ship Configuration.

The work package defines authorized repairs and alterations. It must be based on accurately defined ship configuration to support long lead time planning and material procurement. A ship configuration validation is conducted periodically to verify and re-establish the ship configuration baseline. These validations usually are conducted by the Configuration Data Manager (CDM) with ship's force assistance. The ship armament installation list (SAIL) also requires periodic updating to validate installed ordnance equipment and ORDALT status. In ship's carrying cargo ammunition, ammunition handling equipment is also included.

b. The Ship Alteration and Repair Package (SARP).

The SARP and CSMP are used to define the work package. Several SARP versions may be promulgated . They are:

1. Baseline SARP. An assembly of programmed alterations and CSMP items.

2. Preliminary SARP. The baseline SARP updated to reflect the results of the CSMP purge and pre-deployment work definition test and inspections.

3. Proposed SARP. A SARP updated with cost estimates.

4. Authorized SARP. An SARP updated to reflect work actually authorized.

5. Completion SARP. An authorized SARP updated to reflect work actually accomplished and completion costs.

All of these SARP versions may not be issued for every availability, and some may be combined.

c. Current Ship's Maintenance Project.

With the evolution of phased maintenance planning and improved waterfront maintenance management systems, the CSMP has become more valuable in availability planning. Today it is the basic work package definition document. The first step in work package development is to purge and update the CSMP. PERA or Type Commander assistance is often provided, but the ship's force is still responsible for CSMP accuracy.

d. Tests and Inspections.

After the CSMP has been purged and updated, a Work Package Development Plan (WPD), Pre-Overhaul Test and Inspection (POT&I) Plan or Material Self Assessment Guide is issued. The use of these plans has been influenced by the evolution of phased maintenance. Prior to phased maintenance, POT&I plans were used to ensure that the entire ship was completely tested and inspected before each overhaul. A total ship test and inspection usually is conducted when planning the first phased maintenance availability to provide a material condition baseline. Work Package Definition plans and Material Self Assessment guides are used in planning subsequent phased maintenance availabilities. WPD plans and MSA guides tailor the tests and inspections based on several factors such as the ship's material condition baseline, work accomplished during the prior availability, class maintenance plan, current maintenance problems in the class, and the port engineer's knowledge of the ship's current material condition. The emphasis is to prescribe only those tests and inspections needed to define repair requirements on equipment that is known or suspected to be operating improperly, or to verify the need for class maintenance plan items scheduled for the forthcoming availability. The WPD plan is prepared by PERA based on input from the port engineer. It is issued by PERA after being coordinated with the ship's force, the ISIC,

TYCOM representative, and the technical agents designated by the port engineer to conduct specialized tests. MSA guides are provided by TYCOM. MSA or WPD results are documented, screened and entered into the CSMP.

4. Work Authorization

a. Work Package Documentation.

AWR's produced by the 3-M system are used to document repair requirements and identify planned and authorized alterations. After the work package has been screened, a planning agent will provide cost estimates for depot level repairs and alterations in the work package. The intermediate maintenance activity which has been assigned the concurrent availability (IMAV-C) will review the IMA level work. Either PERA or TYCOM train key personnel in work package management techniques. The ship's manpower budget is developed and work assigned to the ship's force will be scoped in preparation for the Work Definition Conference (WDC) or Work Package Definition (WPD).

b. Work Definition Conference (WDC).

The WDC is chaired by a representative of the TYCOM, normally the port engineer if assigned, and attended by PERA, the industrial activity responsible for the availability, the IMAV-C, designated technical agencies and the ship. SHIPALT drawing development and material procurement status will be reviewed to verify drawing and

material availability. SHIPALT's with unacceptable drawing or material availability will be canceled. The repair package is reviewed based on manpower limitations, work priority and IMA/SF capability and capacity. Additional test requirements or actions needed to complete the work package definition are also reviewed and responsibilities assigned.

c. Authorized Work Package.

The resultant authorized depot work package is transformed into bid specifications, for a private shipyard availability, or job orders, for a Naval shipyard availability; and the ship prepares the final ship's force management plan. Additional non-repair related plans, such as onboard training and off-ship school plans, also will be developed by the ship in preparation for starting the availability. The exact nature of planning actions varies in detail and scheduling depending on the ship's maintenance planning program (EOC, phased maintenance, etc.), the type of availability, and the ship's operating schedule. Precise details of planning for a specific availability can only be covered by the exact planning milestones for each overhaul. Although PERA is funded by the TYCOM and NAVSEA to perform many tasks in preparing the work package, the ultimate responsibility for availability planning remains with the ship.

G. THE ROLE OF SUPERVISOR OF SHIPBUILDING, CONVERSION AND REPAIR (SUPSHIP)

The principal objective of SUPSHIP is to coordinate all contacts and arrangements with private shipyard contractors. SUPSHIP awards and administers shipbuilding, design, conversion, repair, and facility contracts at privately owned shipyards. SUPSHIP is the procurement activity and provides the contracting officer, who is the only individual authorized to contract new or additional work or to release the contractor from any provisions of work specification. Availability responsibilities at SUPSHIP are split between a planning and overhauling. The planning SUPSHIP is responsible for all advance planning for ships in a class, including preparation of the initial bid specification package and award of the contract. The overhauling SUPSHIP administers the availability. Both functions may be performed by the home port SUPSHIP for availabilities limited to his geographical location. The SUPSHIP advance planner is the point of contact throughout the planning phase. After specification completion and contract award, the functions of coordination and liaison among the ship, type commander, and contractor are performed by the overhauling SUPSHIP type desk officer. This individual is the point of contact for the ship on all contractual matters and advises the type commander on matters related to new

work, growth and progress. As the contracting officer for the overhaul, SUPSHIP is responsible for all legal and contract administration functions. In the work package development process, SUPSHIP performs the following functions:

1. **ADVANCE PLANNING**

The Work Definition Conference is when all work to be assigned to the depot level is defined. If the work package is not fully defined at this point, any changes or additions to the contract will be significantly more costly than when originally specified and awarded. SUPSHIP converts the work package into a specification package and puts it out for bids. All bidders must already hold a Master Ship Repair (MSR) contract to be qualified for award. Only after the contract is awarded by SUPSHIP or NAVSEA is the overhaul yard known. Contract award normally occurs about 90-120 days prior to the start of an availability with a coastwide competition (contract bids are accepted from outside the geographical area of the ship's homeport) and at about 30-45 prior to the start of availabilities where bids are accepted only from contractors in the ship's geographical location.

2. **CONTRACT AWARD**

A private sector overhaul is governed by a contract between the Navy and the shipyard. The contractor agrees to

perform a specified work package for a specified amount. Any changes to the package require changes in the amount of award. Changes to the package in a private shipyard require more than just technical restatements of work. Satisfying the legal aspects requires time and money. It is, therefore, important that the bid specification package completely and accurately define work. SUPSHIP awards three types of contracts, (1) Invitation for Bid (IFB), (2) Request for Proposal, and (3) Sole Source Awards.

3. **LIAISON BETWEEN THE SHIP, SUPSHIP AND THE CONTRACTOR**

In a Naval shipyard direct contact between the ship and yard is permissible. In a private yard, contact between the ship and the yard has contractual ramifications. The ship has no contracting authority. The SUPSHIP representative is the single point of contact for the private contractor. The contracting officer is the only one who has the authority to approve additional work or changes to existing work and is the only one who can accept completed work for the government.

Any industrial work that is not the responsibility of the private contractor must be accomplished or coordinated by ship's force. It must be planned and organized to avoid personnel and job interference with the contractor's efforts. The contractor is responsible only for work and testing set forth in the contract

specifications. To eliminate any doubt as to the responsibility for completed work and to minimize physical conflict, ship's personnel may not work on any unit which the contractor is also working on. Any problems between ship's force and the contractor are to be brought to the immediate attention of the SUPSHIP representative for resolution. Most contractor related problems are avoided if the work package and bid specifications are clearly defined and if split responsibility for repair is eliminated in the planning process. Bid specifications are prepared from the authorized SARP as described in the following section on the role of PERA.

H. THE ROLE OF PLANNING AND ENGINEERING FOR REPAIRS AND ALTERATIONS (PERA)

The primary objectives of PERA is to provide intensive management for planning and accomplishing effective, orderly, and timely ship depot availabilities and the efficient use of scarce management and engineering resources through the development of standard documentation, methods, and procedures throughout all NAVSEA organizations having maintenance and modernization responsibilities [Ref. 6]. Each PERA is designed to (1) assist SPMs and TYCOMs in developing and integrating the life-cycle maintenance and modernization requirements for assigned ship classes, (2)

provide direct support to SPMs in specific programs, and (3) support the TYCOMS by providing engineered support for the planning, screening, authorization, and accomplishment of repair and modernization work packages. This includes the task of developing recommended work packages based on accurate work definition in SARP format. PERA performs the additional duties when tasked or funded by the sponsor, NAVSEA SPM, or the TYCOM.

1. **Advance Planning Agent.**

Either NAVSEA or the TYCOM will designate PERA in writing to act as the Advance Planning Agent for specific ship industrial availabilities. This designation gives PERA the authority to act as agent for the NAVSEA SPM and the TYCOM in dealing with the Planning Yard, Planning SUPSHIP, design agents, procurement activities, Naval Supervising Activity, and other involved commands.

As an advance planning agent, PERA integrates modernization and repair requirements into documents directly usable by the industrial activity and is responsible for maintaining effective and timely communications among the Planning Yards, Planning SUPSHIPS, TYCOMS, NAVSEA, procurement agents, and Naval Supervising Activities.

2. Long Range Planning.

PERA provides coordination and implementation of the following tasks:

(1) Maintain liaison with NAVSEA and TYCOMs on PERA programs and with other activities in support of ship maintenance and modernization

(2) Develop and implement a Quality Assurance (QA) program to ensure consistent, high quality PERA products and services

(3) Administer assigned Ship Alteration (SHIPALT) programs

(4) Manage NAVSEA tasks assigned to the Planning Yard or Planning SUPSHIP (as design agent) for SHIPALT Installation Drawings (SIDs) and other documents for authorized work

(5) Prepare and maintain ship repair and alteration histories when tasked

(6) For assigned SHIPALTs, identify material and ILS requirements for entry into the Fleet Modernization Program Management Information System (FMPMIS)

(7) Act as the central manager for procurement, staging and delivery of long lead time material for assigned ship availabilities

(8) Coordinate implementation of the Integrated Logistics Support Management Program (ILSMP)

(9) Manage special material programs

(10) Develop CMPs and associated material usage forecasts to ensure ship systems and equipment are properly maintained. Update the plans and forecasts to reflect as-found conditions

(11) Prepare and manage the development of Integrated Test Plans

(12) Assists TYCOMS in implementing advance diagnostic techniques to improve repair work definition

(13) Assist in configuration status accounting processes. PERA maintains and uses the ship's configuration data during routine operations and reports configuration data base errors to the designated configuration data manager (CDM)

(14) Maintain data bases of material required for equipment repairs. This data base is used in forecasting repair material requirements and costs for availability work packages.

3. **Availability Planning.**

PERA performs the following availability planning tasks:

(1) Manage advance planning requirements for assigned ship availabilities. Establish, coordinate, maintain, and ensure compliance with advance planning milestones. Provide periodic status of planning progress

(2) Develop a proposed comprehensive integrated repair and modernization work package in standard SARP format

(3) Prepare Pre-Overhaul Test and Inspection (POT&I) and Work Package Definition (WPD) plans and material self-assessment documents. Conduct POT&Is and WPDs to determine material condition if tasked

(4) Prepare and distribute preliminary SARP for estimating by the industrial activity

(5) Review the SHIPALT package and integrate it with the repair package. Examine compatibility with planned repairs and availability duration

(6) Prepare and distribute proposed SARP for screening at the WDC

(7) Task activities for planning Title D and F SHIPALTS, via the SPM Contracting Officer Technical Representative for contractor planning yards

(8) Prepare work package assessment for:

(a) The adequacy of the work package to ensure ship's operational reliability and safety during the next operating cycle

(b) The ability of the industrial activity to implement the package within the funding and schedule constraints

(c) The degree of compliance of screening actions with the current work assignment directives and reliability centered maintenance principles

(9) Attend and participate in Work Package Definition Conferences. Develop, document, and retain all lessons learned and incorporate into the planning process

(10) Prepare and distribute an authorized SARP that reflects TYCOM WDC decisions and NAVSEA assigned SHIPALTs

(11) Assess the effectiveness of the advance planning process

(12) Provide cognizant activities with availability planning and material information such as:

(a) Appropriate issues of the SARP

(b) POT&I and WPD plans and reports

(c) Technical specifications

(d) Status and availability of justification and cost forms, SHIPALT records, and SHIPALT installation drawings

(e) ILS information

(f) Machinery Condition Reports

(13) Prepare and promulgate availability completion SARPs as requested.

Although PERA has the capability of performing all of the above duties, they are often not tasked with many of

them. Many of these tasks can be performed by the port engineer, as detailed in the following section.

I. THE ROLE OF THE PORT ENGINEER IN WORK DEFINITION

The port engineer is the TYCOM representative in all availability planning, execution and evaluation matters and works closely with the ship's force to provide technical expertise, personal experience and assistance. The port engineer accomplishes the above through on-board observation and direct contact with the ship's force, other TYCOM representatives and maintenance support activities. The port engineer's role in work definition is outlined in this section.

1. BENEFITS

Within the private sector port engineers have been a fundamental element in bringing about cost effective ship maintenance for many years. The introduction of the port engineer into the Navy did not occur until the early 1980's. The principal benefits gained from implementation of the port engineer concept have been the following:

(1) Increased control over depot maintenance costs and ship material condition.

(2) Continuity of maintenance and engineering judgment.

(3) Centralized responsibility for off-ship repair authorization.

(4) Institution of commercial repair practice expertise.

(5) More accurate Current Ship's Maintenance Project (CSMP).

2. **RESPONSIBILITIES**

Assignment of port engineers has been limited to the Phased Maintenance Program (PMP). The general responsibility of the port engineer is to manage the planning, executing, and evaluation phases of all intermediate and depot level maintenance for assigned ships. Port engineers are members of the TYCOM staff and have responsibility for all off-ship maintenance, including these:

(1) Screen work requests from the ship, analyze problems, and evaluate the need for repairs through personal inspections, surveys, diagnostics, reports, and other means available.

(2) Evaluate the effects of reducing the scope of or deferring work and take appropriate screening actions.

(3) Evaluate all change orders and take appropriate screening action to defer, reduce scope, accomplish,, or otherwise resolve problems.

(4) Review maintenance and modernization plans and tasks to ensure their worth and whether proper logistic resources are available.

(5) Review CSMPs of assigned ships and assist ship's crews in ensuring they accurately reflect the material condition of assigned ships.

(6) Provide the focus and necessary technical expertise to define the most appropriate scope

for specific repairs based on condition assessment.

The port engineer's depth of expertise is hull, mechanical, and electrical equipment. For assigned ships with extensive ordnance systems, the port engineer is typically assisted by a combat systems engineer, who has similar responsibilities for anti-air, surface, underwater warfare, and command and control equipment.

3. **WORK DEFINITION PROCESS**

The work definition process identifies repair work to be accomplished and combines that work with authorized SHIPALTs into an integrated availability work package. In phased maintenance, this process is called Work Package Definition (WPD). Key elements in WDP are the following:

a. Work Package Definition Plan (WPD Plan).

WPD Plan is a listing of tests and inspections that should be performed during the Work Definition Inspection (WDI) to define a comprehensive repair package. This document is developed by the PERA for use by the port engineer in conducting the WDI. The listing is derived from the Class Maintenance Plan (CMP) or its accompanying Long Range Maintenance Schedule (LRMS), Naval Ships' Technical Manual (NSTM), equipment technical manuals and other sources. The listing includes tests and inspections for equipment and systems that have historical problems and other mandated time-directed tests and inspections .

The plan consists of three parts, a WPD Plan index, a recommended test and inspection agenda, and an individual equipment and system Repair Inspection Record (RIR) sheet. The WPD plan index lists all of the significant maintenance items on the ship, and is commonly referred to as a Ship System Configuration Index (SSCI). The agenda shows the interrelationships of various tests and inspections and is used as a recommended schedule for execution of those tasks. RIR provide criteria for conducting inspections and tests.

b. Work Definition Inspection (WDI),

The WDI is a set of tests and inspections, reflected in the WDP Plan, to determine the material condition of a ship's systems and equipment and to pinpoint those in need of maintenance. In many respects, the WDI is similar to a POT&I. While both the POT&I and the WDI provide a basis for repair work decisions, POT&Is occur once per operating cycle, before the overhaul availability. Because of the long interval between overhauls, the POT&I is broad in scope, covering most of the ships systems and equipments presumably to identify all potential work items in order to reduce the risk of inter-availability failures.

For ships in phased maintenance, several program elements necessitate a modified work definition procedure. These elements include shorter, more frequent

availabilities; a flexible cost-type contract vehicle; and increased emphasis on condition assessment. WDI's are conducted about once every 15-18 months and yield a more concise and presumably usable preliminary SARP. The systems and equipment examined during a WDI are typically only those that have historically had problems or have been specified for time-directed assessment.

c. ***Work Package Definition Report (WPDR).***

A WPD Report is prepared by PERA, acting as the TYCOM agent, immediately upon completion of a WDI. PERA records the results in the form of a WPD Report to provide the port engineer and TYCOM staff a useful list of potential availability repair work while awaiting the preliminary SARP and to serve as the basis for the preliminary SARP. The report consists of the WPD Plan, completed Ship's Maintenance Action Forms (4700.2Ks), and marked-up AWR-forms.

d. ***Preliminary SARP.***

The preliminary SARP is used by the port engineer to review initial repair decisions, to obtain preliminary estimates of availability costs from the planning supervisor, and to ascertain which items may be affected by known material procurement difficulties. The port engineer, in a meeting with the planning supervisor and shipyard representatives, reviews the preliminary SARP in detail to

identify high priority items which require long lead-time material and exacting work specification development. The port engineer, with the concurrence of the planning supervisor, usually sanctions the shipyard to begin work in the long lead time material procurement and specification writing for these items by issuing an authorization letter.

e. Work Definition Conference.

WDCs are held about six months in advance of availabilities for the purpose of authorizing work to be performed. The conference is typically chaired by the port engineer and attended by personnel from the TYCOM staff, ship's force, planning supervisor, and PERA. Often a pre-WDC is held to discuss preliminary repair decisions and to make preliminary assignments of the work among the depot, IMA, and ship's force. The purpose of the WDC is to make a final determination of the SHIPALTs and repairs that are to be accomplished by the industrial activity, intermediate maintenance activity, and ship's force. It refines the preliminary SARP into an authorized SARP.

The following actions are taken in preparation for the WDC:

(a) Review the preliminary SARP in detail

(b) Review the ship's CSMP

(c) Review the shipboard vibration data logs

(d) Interview leading petty officers and work center supervisors to document all new work

(e) Inspect and verify the need and scope of SARP line items, ensuring that each SARP repair item is specific

(f) Prioritize all depot level repair items, ensuring that the entire logistics package for the planned alterations is in place

(g) Assess cost estimates of any new repair items and reassess estimates for existing items that appear to be too low or too high and revise estimates for jobs for which the scope has been changed

(h) Adhere to manday constraints imposed by OPNAV for each PMA work package The authorized SARP must allow for subsequent emergent and growth work within this manday limit

(i) Identify low priority items as candidates for cancellation or deferral

(j) Achieve mutual agreement on the contents of the entire package

(k) Provide ship's force with a list of low priority items and manday limitations and encourage ship's force to perform it's own material condition assessments and to make sound trade-off decisions before submitting additional work items for accomplishment during the availability

(l) Employ condition-based maintenance principles of Reliability-Centered Maintenance (RCM) decision logic in making or recommending repair authorizations to ensure discipline and consistency in the difficult process of prioritizing work.

f. Authorized Ship Alteration and Repair Package.

The authorized SARP is the finalized work package resulting from the WDC process. It is prepared by PERA immediately following the WDC based upon decisions made at

the conference. The SARP becomes the foundation for formal work package cost estimates and detailed work specifications prepared by the planning supervisor or the PMA shipyard. Once the authorized version of the SARP has been received, the port engineer works closely with the planning supervisor and the shipyard in their preparation of work specifications and in identifying and procuring maintenance materials. The port engineer is involved in the following ways:

(a) Participating in planning supervisor ship checks and clarifying questions that the specification writers have regarding the exact scope of each job listed in the authorized SARP.

(b) Informing the ship's PMA coordinator of any changes to the authorized SARP. Because the authorized SARP is published about six months prior to the availability, changes that affect the work package often occur. Completed and new work items must be addressed. If a job in the SARP is accomplished prior to the availability, the port engineer must adjust the PMA package accordingly and must add any new work if unexpected equipment degradation or failure occurs. In this case, low priority jobs may have to be deferred or reduced in scope to accommodate the new work within the manday limitations. Generally, more work is added to the PMA package following the WDC than is deleted. It is the responsibility of the port engineer to exercise discipline in controlling the size of the work package and simultaneously ensuring a logical overall prioritizing of work items.

(c) Modifying the scope of the authorized work package as necessary, if material is not obtained.

(d) Ensuring the overall work package adheres to the OPNAV-imposed manday limits.

g. Intermediate Maintenance Availability (IMAV) Work Package

Once the port engineer has received the IMAV work package, about 45-120 days prior to the availability (A-45 to A-120), he takes the following actions:

(a) Reviews the IMAV work package in detail to ensure no items interfere with work screened to the shipyard for PMA accomplishment.

(b) Ensures that all items effecting the ability of the ship to light-off (start the engines) can be completed prior to the scheduled PMA light-off date. In cases where potential problems exist, the items are rescreened to the shipyard as new work to avoid PMA schedule delays.

(c) Ensures there is no redundancy or overlap between the PMA and IMAV work packages.

h. Pre-Arrival Conference

At about A-45 to A-30, the port engineer chairs a Pre-Arrival Conference which is usually attended by representatives of the ACO, phased maintenance contractor, Naval Supply Center, Squadron, Group, ship's force, and IMA. The purpose of this meeting is to discuss a wide range of pre-availability preparation topics that directly impact the ship's schedule for the first weeks following completion of deployment. These include pier and berthing arrangements, fuel offload, boat offload, ammunition offload, UNREP winch offload, refrigerated cargo offload, dry stores offload, tank gas-freeing and cleaning, crane services, barge services, asbestos lagging insulation removal, early work

start items, transportation requirements, and WDC follow-up actions.

The port engineer's primary role is to oversee the interaction of all representatives to ensure that a reasonable schedule is established. The schedule should enable the timely accomplishment of all required items without placing unnecessary requirements or restrictions on the ship's force. If ship's force is not represented, the port engineer must inform them of the schedule and any other pertinent issues that have arisen at the Pre-Arrival Conference.

Acting as principal points of contact between the ship and various other PMA participants, port engineers are the decision making focal points. Although agents from NAVSEA, Planning Supervisor, ACO, TYCOM, PERA, the IMA, phased maintenance shipyard, and equipment vendor technical representatives are involved in the success of an availability, the port engineer is meant to be in the best position to make sound, cost-effective repair and alteration work decisions. They are there to provide continuity of management and an added dimension of engineering and logistics judgment through first hand working-level knowledge of the ship and its material condition. Their personal experience and technical expertise in day-to-day ship repair practices are more extensive than available in a single individual under the other maintenance strategies.

The port engineer concept enables the TYCOM to provide ships with valuable, hands-on services that are not otherwise available from type desk officers.

The next chapter presents an evaluation of current problem areas related to work package planning and provides observations on the work definition process.

IV. EVALUATION OF RESEARCH FINDINGS ON SURFACE SHIP MAINTENANCE AND REPAIR PLANNING

This chapter provides an evaluation of problems related to work package planning and other observations of the work definition process.

A. WORK DEFINITION RELATED PROBLEMS

As clearly delineated in the preceding sections, the steps and procedures for accurately defining repair work are in place. Based on interviews conducted with 5 port engineers, 4 type desk officers, 6 PERA representatives, and other individuals within the various maintenance activities, the problems in work definition and work package planning stem not from the existing guidelines and policy, but from the management of the process. Poor CSMP management by ship's force and lack of coordination in the planning process by the TYCOM representative, and not the available planning tools, are where the inadequacies exist.

1. CSMP ACCURACY

CSMP accuracy is still the major cause of problems in the work package development process. The CSMP is the primary document used to feed the SARP and to create the work package. Unless the CSMP is properly purged and validated by ship's force, repair work will not be accurately defined. In turn, specifications will be created

and bids made on work not necessarily requiring accomplishment, growth of authorized jobs and new work will be unnecessarily large, unnecessary repairs may be accomplished while urgent work may be deferred or go unnoticed. This lack of proper CSMP management by ship's force results in highly costly and unnecessary expanded work definition efforts.

2. **PLANNING PROCESS**

The planning process for an availability involves many different players. The coordination effort required is colossal. If logistic support for mandated SHIPALTs and SHIPALT drawings are not acquired in time for the availability window, modernization will not be accomplished. Deferral or cancellation of authorized SHIPALTs due to poor planning efforts degrades the modernization process and, thus, impairs fleet readiness and capability.

If maintenance and modernization requirements are not accurately defined and coordinated, growth of poorly defined authorized repairs, new work, and job cancellation and deferrals equate to greater spending, greater manday usage, and increased contractual problems for ships in civilian shipyards. These problem areas are further examined in Chapter V.

3. RELATED PROBLEM AREAS

On the basis of the interviews mentioned in the opening paragraph of this section the following related areas are perceived as having problems.

a. Maintenance ADP Compatibility

It is a concern of many maintenance managers that presently there does not exist an ADP program that allows interface between all of the maintenance activities. Without an electronic linkage the results from inspections and tests documented by NAVSSES on the NAVSSES database are not accessible by the other maintenance activities. Therefore, the results are not readily available to maintenance planners. Furthermore, since maintenance planners such as the port engineers do not have access to these results readily available via the ADP system, maintenance planners are not able to keep and maintain an up-to-date data base on what repairs and tests have recently been conducted and the results of these indicators. While the RSGs, IMAs, automated ships, PERA, and others are now implementing MRMS, this system is not used by other key activities such as PMT, NAVSSES, NAVSEACENs and others, therefore, its application is currently limited.

b. Resource Utilization

Ships and TYCOM representatives may not be taking full advantage of the resources available in the planning

process. It is the concurrence of many of those interviewed that it is not necessarily the shortage of funding which prevents such utilization, but in many instances information. For whatever the reasons, it is the conclusion that ship's and their type commander's representatives are not taking full advantage of the resources available to help identify needed repairs, correct deficiencies and locate potential problems areas. There is a multitude of talent available to assist in the work planning process which is not being utilized to its potential. Several of the responses as to why these sources are not being used is that they are not perceived as necessary. Many port engineers lack confidence in the ability of other activities. The background of most of the port engineers contains no previous interface with Navy activities or exposure to the Navy's culture. If port engineers were to receive an indoctrination into the Navy and gain a better perspective of the roles of other maintenance agents, better resource utilization may be possible.

c. Maintenance Rivalries

There exists among the many planning tools, the ability of different activities to perform the same tasks. There is also a lack of clear delineation of which type commander representative is to perform which tasks and where

the ultimate responsible for accomplishment of these tasks lie. The type desk officers for phased maintenance ships have a port engineer available to assume many of the tasks normally associated with type desk officer duties. It is a typical comment of the type desk officers that they often have difficulty is resolving the conflict this lack of clearly delineated responsibility begets. A common belief of the port engineers is that if they are assigned, a type desk officer is not necessary and detracts from the port engineers ability to perform his role as coordinator and final decision maker. Many maintenance managers believe that the port engineers do not understand Navy policy and procedures and lack a desire to become familiar with standard Navy operations. They are perceived by many as being somewhat arrogant and inflexible and this lack of understanding often results in diminished decision making ability at the TYCOM level.

Another relation that is frequently strained is the relationship between the ship's Commanding Officer and the port engineer. The port engineer has final authority on work prioritization, not the Commanding Officer who, although he may not be an engineering expert, has ultimate responsibility for the ship and is accustomed to final decision making authority in all matters concerning the ship.

There also exists to varying degrees a rivalry between the TYCOM representatives, be they the port engineer or type desk officer, and the PERA representatives. Approximately one half of all those interviewed strongly believe that all responsibility for maintenance decisions should remain at the lowest organization level applicable. These individuals act in an autonomous manner concerning maintenance management and strongly oppose efforts to standardize surface ship maintenance procedures. Other maintenance managers are strongly in favor of standardization initiatives such as "autospecs", an automated specification program which will create standardized repair specifications regardless of geographical location or SUPSHIP. Recently the PERA organization began standardizing it's policy and procedures for all ship classes. Although standardization reduces the flexibility of the port engineers and type desk officers, it should (1) increase resource utilization by eventually weeding out those resources not in demand, (2) eliminate the expense of sustaining these resources, and (3) allow maintenance managers to focus on those resources with should provide the highest rate of return their maintenance dollar.

Other specific comments regarding maintenance improvements are contained in Chapter V.

B. EFFECTIVENESS AND SUCCESS OF DIFFERENT MAINTENANCE STRATEGIES ON WORK PACKAGE DEVELOPMENT

This section evaluates the effects on work package development of different maintenance strategies, and the success of these strategies in creating and managing work packages.

The key elements to a successful maintenance availability are the same regardless of what maintenance strategy is applied to the ship. The Current Ship's Maintenance Plan (CSMP) is the main ingredient, and it is ship's force responsibility to keep the CSMP up to date and accurately reflecting the material condition of the ship. The CSMP is the medium the ship uses to tell the maintenance community what they think needs to be repaired. The ship's CSMP is viewed closely by squadron material personnel. This monitoring by squadron helps the Type Commander (TYCOM) ensure the accuracy of their ships' CSMPs. The CSMP is the source of Automated Work Requests (AWRs). The Readiness Support Group (RSG) or other TYCOM representative reviews these requests by use of the Maintenance Resource Management System (MRMS) system and can assign, defer, or reject work requests quickly, without requiring any paper work. The automated CSMP, combined with the implementation of MRMS and the continuous maintenance philosophy used by the RSGs and other TYCOM representatives, have created a responsive intermediate maintenance program. This increased response

to CSMP originated work requests has, in turn, helped to reduce the size of the CSMP. Repairs that once may have been deferred to the next scheduled availability are performed more quickly if an IMA has the capacity to do so. The twofold advantage here is that the ship gets increased response to their requests and the Intermediate Maintenance Organizations (IMAs) eliminate any idle capacity.

As mentioned in Section E of Chapter III, there are numerous planning tools available to improve the work package development process. It is the successful coordination and proper employment of these tools that is necessary. First, the ship needs to know what is wrong with it and needs to properly document maintenance requirements. Secondly, coordination between the ship, squadron personnel and other TYCOM representatives (i.e. Type Desk Officers and port engineers) is essential to the accomplishment of documented repair requests in a cost effective manner without wasting valuable assets or time and money due to duplication of effort and unjustified repair efforts. In order for this cohesion of repair efforts to exist, a thorough knowledge of all the available maintenance aids by key personnel is essential.

In many ports, the RSGs, as TYCOMs agent, act as intermediate and emergent maintenance brokers, possessing the expertise necessary to assign technical assists (TAVs) or voyage repairs (VRs). In addition to an in-depth

knowledge of the maintenance community, careful coordination and communication between all repair agents is crucial. The ship, TYCOM representatives and all other designated agents, must know what each other has planned or authorized. For availabilities, the WDC is where responsibility is assigned. For ships in PMP, the port engineer is the single individual responsible for coordination. For all other programs, the Type Desk Officer performs this duty. [Ref. 1]. For emergent work assignment, there must be one agent responsible for assigning the repairs, usually either the RSG or the Type Desk Officer. Although all classes of ships are assigned periodic intermediate maintenance availabilities (IMAVs), depot level repairs are accomplished differently. How these different maintenance strategies affect the work package planning process is examined in the following section.

1. PHASED MAINTENANCE PROGRAM

As mentioned above, the planning time for PMAs is reduced considerably from ROHs. If the port engineer (PE) assigned to the ship possesses a thorough knowledge of the planning process and the timing of the various milestones, the work package development for ships in PMP is more likely to go smoothly. As noted, the CSMP is the principal maintenance document and is the responsibility of ship's force. While a port engineer is not necessary for an

accurate CSMP, the PE is a valuable contributor to the work definition process due to in-depth knowledge of marine engineering. One of the major benefits of having a port engineer assigned is the continuity provided from availability to availability. Commanding Officers and Chief Engineers may come and go, but ideally the port engineer remains. PE knowledge of the ship's plant and systems should be second to none.

As with other programs, knowledge of the maintenance tools available to the PE is crucial in identifying maintenance problems and how to correct deficiencies in the most cost effective manner. With the shortened planning time, the port engineer is the one responsible to make sure nothing is overlooked. The PE is responsible for planning and screening all work requests from the ship; evaluating the need for repairs; reviewing maintenance and modernization tasks to ensure the availability of correct logistics resources; reviewing the CSMP for accuracy; coordinating and conducting the WDI; assisting other TYCOM staff with reviewing and prioritizing SHIPALT requests; reviewing the IMAV work package to ensure no interference with work screened to the ship yard; and chairing the ship's pre-arrival conference.

The shortened duration of PMAs also impacts the modernization requirements. SHIPALT planning and programming generally takes from four to seven years.

Special planning is required to meet the small PMA window of two to three months. Additionally, some alterations must be accomplished in conjunction with certain repairs and are typically performed during an ROH, but now must be accomplished during successive PMAs. The shortened PMA length means alterations must be divided into increments and partially accomplished during two or more successive PMAs. Ships in the PMP use a Five-Year Modernization Plan. This plan is developed, updated and promulgated by PEPA. Since mandays and funding are limited, consideration must be given to the mix of repairs and alterations for each availability. SHIPALTs must be planned so needed repairs are not crowded out of the package. It is the port engineers job to balance modernization with repair by accomplishing as many repairs as necessary and as much modernization as possible to optimize the material condition of the ship.

As opposed to lengthier overhauls, there is less time for identifying and ordering required materials because material requirements are often determined by equipment assessments either shortly before or during the overhaul. In the PMP, the shipyard is responsible for providing all the repair material. The government provides material only when the yard cannot acquire it in time to meet completion schedules. The Insurance Item Management Program for Equipment and Parts (IIMPE/P) was developed to identify mission-critical hull, mechanical and electrical (H,M&E)

equipment. Parts are stocked as insurance items in the supply system and are available only for casualty reports (CASREPs) and availability work stoppage situations.

One advantage to the shortened window for planning is that the ship's material assessment is conducted closer to the beginning of the availability. This combination of condition directed repair, timely material assessments, and the continuous maintenance strategy has helped to improve CSMP accuracy, and in turn, the work definition process.

2. ENGINEERING OPERATING CYCLE (EOC)

Ships under the EOC maintenance strategy do not have as much flexibility in the planning process as do those in PMP. Pre-overhaul Test and Inspection (POT&Is) are conducted over an 8 month period between 14 & 6 months before the start of the availability. The actual material condition of the ship at the start of the overhaul may differ largely from 6 months previously. Many jobs may have been accomplished and many other items may have failed. Work that was accurately defined at A-180 may well be inaccurate when the availability actually begins. Without an accurate definition of needed repairs, the package cannot be properly planned and executed.

Additionally, EOC ships have no port engineers. The time between overhauls is 4-7 years, in which time 2-3

different Chief Engineers may have come and gone, taking their knowledge with them. Without the port engineer and a more recent set of inspection results, the planning process for ships in EOC presents a greater challenge.

3. PROGRESSIVE MAINTENANCE

The progressive maintenance strategy is the only one that provides the ship's force with almost no maintenance responsibility. The uniqueness of this strategy makes it very difficult to contrast and compare with others. When a ship's force does not have the capability to perform organizational-level work, they may have difficulty in identifying material problems and deficiencies. If they are unable to properly define work requirements, the CSMP will not be accurate, and the resulting authorized and approved SARPs may contain invalid work requirements or provide the opportunity for a great deal of growth and new work. Once again, without an accurate CSMP, proper planning is impossible.

Regardless of the maintenance strategy applied to a particular ship, the recurring elements of successful work package planning and development are the same, namely, (1) CSMP accuracy and currency (2) advance planning, and (3) proper utilization of available maintenance tools. There are many maintenance agents within the NAVSEA and type commander organizations, many of which are capable of

performing the same tasks. As long as there is funding to keep all of these agents actively employed, there is no real duplication of effort, just a choice of resources available. The intra-organization capabilities are the first to be challenged. If the type commander has the choice of utilizing a cost-reimbursable activity such as PERA or non-reimbursable agents such as the port engineer and PMTs, the non-reimbursable agent will be selected. There is currently a trend to use PERA less and less in areas such as CSMP validation, POT&Is, and any other assistance that in the past was "nice to have", but could be accomplished without additional expense by ship's force or type commander's representatives. If maintenance funding continues to decrease, then even type commander's assistance will be limited. The forecast is for more and more responsibility to remain with ship's force [Ref. 3]. How this increased shipboard responsibility will effect the quality of life for those on sea duty is not known, but one can only guess it will not be accepted without protest.

One of the maintenance assistance programs currently in operation is the Assessment of Equipment Condition (AEC) program and the Performance Monitoring Team (PMT). The utility of the AEC and PMT is evaluated in the following section.

C. ASSESSMENT OF MATERIAL EQUIPMENT (AEC) AND PERFORMANCE MONITORING TEAM (PMT)

In December 1988, the Systems and Equipment Maintenance Monitoring for Surface Ships (SEMMSS) was disestablished and the Assessment of Equipment Condition (AEC) Program Management Office at NAVSSES was developed in its place. Program oversight was transferred to the Surface Ship Maintenance Division in NAVSEA. The goal of the reorganization was to result in program enhancements to realign systems monitored to reflect type and fleet commanders' priorities and encompass all surface ship classes. The reorganization has mandated a more selective choice of systems in order to assist the type commander in short term future repair calls and follow up in post repair quality assurance. [Ref. 7].

AEC categorizes the Navy's maintenance philosophies as (1) run-to-failure (corrective maintenance), (2) time-based fixed frequency (preventive), and (3) predictive (condition-based). According to reference 7, the higher implementation costs associated with the use of predictive maintenance are considerably lower than the cost savings incurred by the resulting reduction in the number of equipment failures [Ref. 7]. This article states that only a small portion of maintenance decisions made during the work definition process are based on the principles of reliability-centered maintenance. The reason for this lack of RCM is the non-

availability of "continuous, reliable, repeatable shipboard condition assessment tools" [Ref. 7].

The article concludes that the answer to the lack of condition-based information is to install a shipboard computer based expert system to monitor and assess machinery condition through on-line sensors and manually collected data. NAVSSES is currently conducting a pilot program to test this system underway on eight ships.

Until the advent of such a condition-monitoring mechanism, the assessment of equipment onboard ships is conducted, in part, by the Performance Monitoring Teams. PMTs are used in two ways: (1) To conduct pre and post-availability analyses (time-directed) and (2) conduct condition-directed analyses as tasked by the TYCOM representative. Regardless of when performed, the analysis is used to determine the need for maintenance action. With the current maintenance budget trends, TYCOMs are employing to a greater extent than ever the philosophy of "if it ain't broke, don't fix it".

The PMTs are responsible for taking the AEC program to the fleet. PMTs work for the type commanders but receive all equipment and training from the AEC branch at NAVSSES. The PMTs report to the RSGs but are funded by NAVSEACENs. The PMTs are another one of the maintenance availability planning tools that when properly employed contribute greatly to the work definition process.

The PMTs represent a valuable resource to the type commanders in that they are located on the waterfront and are readily accessible as a type commander representative to visit ships on short notice to help identify the cause of equipment failure or malfunction. PMTs are in great demand in this environment of reduced funding because they are not a reimbursable activity and there is no incremental cost involved with the number of ships visited or hours spent aboard.

It is the opinion of the experts on Assessment of Equipment Condition (AEC) that the PMTs are a necessary and vital link in the evolution of predictive repair. If condition-based repair is to continue and advance, then PMTs will play an even greater role in work definition [Ref. 3].

With the hastening of current and future reductions in fleet maintenance spending and as the Navy's maintenance strategy goes more and more to condition-directed and less to time-directed, the employment of equipment assessment tools will be even more essential in determining what to fix with limited maintenance funding. These funding cuts are coming at a time when the mix of ships is changing and maintenance managers are more accustomed to depot than organization-level repair [Ref. 3]. The solution for these managers in the past has been to throw more money at the problem until it goes away. When the maintenance coffers are empty, and the commanding officers afloat can no longer

fund shipboard repairs by outside agencies, then, and only then, will resourceful maintenance management prevail. It is readily apparent through interviews with various maintenance managers on both coasts that neither SURFPAC nor SURFLANT has yet to experience any significant decreases in maintenance funding and, therefore, have not significantly altered the way they manage their maintenance budgets.

The maintenance funding environment of the early eighties has influenced the philosophy of today's maintenance managers. Presently, there exist all the planning tools previously cited and more. Obviously, drastic reductions in maintenance funding will not allow for the survival of this resource rich environment. When the time comes the "nice to have" items will be separated from the "mission essential"-tile and terrazzo deck coverings will be accomplished by ship's force at best-and non-critical or non-safety violations will be accomplished by ship's force or deferred until current fiscal policy changes.

The final chapter answers the research questions outlined in Chapter I and offers some potential areas for further research.

V. CONCLUSION

A. RESEARCH FINDINGS

The answer to the first research question regarding the procedures involved in work package development is detailed in Chapter III. All of the planning tools and procedures available to maintenance managers and planners are described and evaluated for effectiveness. The origin of work package planning is the Current Ship's Maintenance Project (CSMP), which is produced by the ship's force. The CSMP, once purged, validated and screened by TYCOM, is merged by PERA with applicable SHIPALTs to create the SARP. The SARP, once authorized, is turned into bid specifications by SUPSHIP. These specifications become the contract between SUPSHIP and the private shipyard.

Answers to the second research question concerning responsibility for work assignment and accomplishment differ depending upon the level of maintenance performed. All organization level maintenance is the responsibility of ship's force. Intermediate level maintenance assigned to an intermediate maintenance facility is screened and assigned by the type commander's representative. Once a job has been accepted by the type commander's representative for action, it is his responsibility to see to its accomplishment.

Depot level work contracted to a private ship yard has contractual responsibilities which are administered by SUPSHIP. Work is assigned by SUPSHIP through contract award of bid specifications. It is the contractor's legal responsibility to accomplish all work specified and it is SUPSHIP's responsibility to make sure the contractor meets all of his obligations.

The third research question asks about implementation of work definition and work package planning policies. Most maintenance managers claim that although they have different sources available to meet their maintenance requirements, these efforts are not performed in duplicate. While either a port engineer or a PERA representative may be utilized to assist ship's force with purging and verifying the CSMP, only one agent is used. If a piece of equipment fails, there are many experts that may come aboard and evaluate the cause of failure-IMA, MOTU, NAVSEACEN, PMT, civilian contractor, etc. Employing the philosophy of accomplishing repairs at the lowest level required mandates a hierarchical approach to equipment failure trouble-shooting. With the increase in condition-based maintenance, time-based repairs and evaluations are diminishing. This results in fewer tasking involving duplication of effort. Currently, PMT may have a time-directed requirement to evaluate a piece of equipment that INSURV or Propulsion Examining Board (PEB)

may have just evaluated. If time-directed evaluations become condition-based, this redundancy will be eliminated.

This thesis has identified most of the maintenance planning tools available and their application in the work definition and work package planning process, and the following observations were made:

(1) Each organization in this complex process has a charter and plays a role in maintenance management. There are no real, obvious, systematic problems with work definition and the work planning process. All of the elements for a successfully planned and executed work package are in place. How these elements are employed determines the success or failure of the work package. If (a) the ship's force has an accurate and current CSMP, (b) the port engineer or other representative is able to fund the proper balance of repair and modernization within the budget and manday constraints, (c) the port engineer or other TYCOM representative knows the technical assistance available, and (d) the port engineer or other TYCOM representative is able to properly prioritize work to be accomplished, the end result will be a fleet maintained to the maximum degree achievable within the funding and manday constraints.

(2) The problem areas in ship maintenance and repair lie not within the work package development/work definition areas, but in the management of the system. PERA is an

organization capable of performing a variety of tasks. They are also cost-reimbursable and receive tasking from two different Type commanders (COMNAVSURFPAC and COMNAVSURFLANT) with two varying philosophies on how their ships should be maintained. Standardization is difficult with two different sets of requirements. PERA can only perform those areas of planning for which they are tasked. Each TYCOM representative has differing view on how to employ PERA. They also have a differing view on how to employ their port engineers and their Type Desk Officers. These views range from "PERA is not needed at all" to actually having the PERA perform all of those tasks outlined in Chapter III.

(3) There exists to a certain degree a sense of rivalry between some port engineers and the PERA representatives. Some of the other type commander representatives do not understand the role of PERA and how they fit into the work package planning process. As mentioned early, PERA has recently under gone a reorganization, the impact of which has yet to be fully determined. They now operate with standard procedures between the three offices. A problem with consistency occurs due to the independent, autonomous nature of many of the type commander's representatives. Each type desk officer may decide differently on how he would like to involve PERA in work package planning. Unless there are standardized procedures for what PERA should and should not perform, these assets will be continually under

utilized if manned for full utilization. It is the type commander representative who ultimately decides what he can fund and what must be eliminated from the work package. If the TYCOMs cannot afford to fund the tasks that PERA was established and chartered to perform, they must be performed by someone else.

(4) There does not appear to be a need for any additional planning tools in maintenance management. There does appear to be a need for standardization to the maximum extent feasible. The type commanders need to establish and standardize how PERA and other support agents should be utilized. The utilization of these assets should be consistent from availability to availability, from port to port, and from maintenance strategy to maintenance strategy.

(5) Each port engineer operates differently. Such differences defeat the intent of providing consistency and continuity in work package development and management.

The following specific comments concerning the performance of port engineers were made by other type commander representatives, on both the east and west coast and represent a sampling of the responses received:

(a) port engineers do not understand Navy ship uniqueness and requirements

(b) port engineers lack an understanding of the duties and responsibilities of the surface force maintenance officer

(c) there is no clear delineation of responsibility between the type desk officer and port engineer

(d) expand the use of port engineers to all ship classes and standardize their responsibilities

(e) port engineers should work for the squadrons, not the surface force maintenance officer.

(f) there is no need for both a port engineer and a type desk officer.

Through standardization of the role of the port engineer, many of these objections may be eliminated or reduced. It is the port engineer's role to provide technical expertise and shipboard engineering experience to ships being maintained under a condition-based maintenance philosophy.

Maintenance work requirements can only be cut so much. Once the minimum has been established, probably through a means of trial and error, other areas such as shore-based assist teams, will need to be cut. It appears that the TYCOMs are now experiencing that process, where funding is cut from their budgets. A time will come when the minimum work to sustain maximum availability to meet the current threat is established. When the TYCOMs can no longer afford to fund the tasks currently performed by the Paras, then it will be time for them to assume those tasks and for the Paras and other support organizations to be cut or disestablished.

B. AREAS FOR FURTHER RESEARCH

The fourth research question asked for areas for further research, the following areas are suggested:

(1) The ability of the TYCOM to assume all duties currently performed by PERA. If the TYCOM becomes unable to fund PERA to a level where they are able to stay in operation, what are the costs associated with transferring the planning functions and SARP preparation functions to the TYCOMS.(Cost-benefit analysis).

(2) The ability of the Intermediate Maintenance Activities (IMAs) to assume greater responsibility in accomplishing depot level work. This question is in two parts: (a) What capability to perform depot level repairs do the intermediate maintenance activities possess, and (b) Are the IMAs currently manned to a level where the capacity to perform depot level work exists?(Cost-benefit analysis).

(3) The feasibility of establishing and using OP-43 issued standards for the execution of maintenance availabilities regardless of geographical location. Establishment of these standards could result in (1) standardization of the utilization of PERA in the work package planning process, (2) standardization of the use of port engineers as maintenance managers, (3) one maintenance philosophy for all ship classes, and (4) standardization of SUPSHIP policy and procedures. In order for improvements in maintenance management to occur, there must exist a standard, baseline policy. Standardization is lacking in all areas of maintenance management.

APPENDIX A-GLOSSARY OF TERM

AAV	Aviation assist visit
AAW	Anti-air warfare
ACC	Automatic combustion control
ACF	Accomplishment confidence factor - The percentage of PMS records, as accomplished, which is evaluated as actually having been performed.
ADP	Automated data processing
AEL	Allowance equipment list - Describes and establishes a quantity and range of general portable items to carry out a shipboard function necessary for the accomplishment of the ship's operational mission.
AER	Alteration equivalent to repair - An alteration which replaces existing parts and equipments with like items of later or more efficient design.
AMS	Alteration management summary - A computer-produced report containing a record of approved alterations in individual ships.
ANSUL	Private corporation that manufactures firefighting equipment
APL	Allowance parts list - A number assigned to equipment that describes the manufacturer and model of the equipment/component.
APN	All-purpose nozzle
APE	Aviation readiness evaluation
ASF	Assist ship's force (funds) - A portion of COMNAVSURFPAC'S repair funds allocated to a routine naval shipyard job for ship's force use for the requesting of miscellaneous shipyard labor support for ship's force work package.
ASI	Annual supply inspection
ASIR	Aeronautical shipboard installation representative
ASROC	Anti-submarine rocket

ASW	Anti-submarine warfare
AT	Acceptance trial
AUTODIN	Naval communications term used to indicate computerized communications in handling card or narrative traffic
AWTT	Above-water torpedo tubes
AWR	Automated work request (OPNAV Form 4790/2P)
BACD	Basic alteration class drawing - The first complete set of installation drawings prepared for an alteration for a given class of ships.
BEDD	Best estimated delivery date
BOH	Baseline overhaul - First overhaul in an engineered operating cycle program to accomplish repairs and alterations required to satisfy baseline class material condition and configuration.
CASCAN	Casualty cancellation report - A report canceling casualty reports (CASREF's) because they no longer represent a significant degradation of material readiness.
CASCOR	Casualty correction report - Reporting repairs have been completed or temporary repairs have restored adequate capability to perform the designed mission. (This does not imply that more permanent repair is not required.)
CASREP	Casualty report - An expeditious means of reporting a diminished combat readiness posture. Advises the operational chain of command of personnel, equipment, material condition which limit operational readiness; also alerts logistical commands.
CC	Corrosion control
CCB	Configuration control board
CCTV	Closed circuit television- Intra-ship or activity television.
CETS	Contractor engineering technical services - Highly qualified civilian electronics technicians

	from private industry are contracted to serve aboard ship.
CFS	Contract field services
CHT	Sewage collection, holding and transfer system
CIS	Commercial industrial services contracted to supplement IMA services
CLA-VAL	Clayton Automatic Valve Company
CMP	Class maintenance plan
CMPO	Controlled material petty officer
COH	Complex overhaul
COLUMNS	Refers to single position of an 80-character line on SMAF Form 1
COSAL	Coordinated shipboard allowance list - A computer-generated list of electronics, ordnance and hull, mechanical, and electrical (H,M&E) equipment/components aboard a naval vessel.
COTP	Coast Guard Captain of the Port
CO2	Carbon dioxide
CRES	Corrosion resistant steel
CRUDES	Cruiser/destroyer ship types
CSMP	Current ships maintenance project - A computer listing of all corrective and preventative maintenance that has been deferred because of operational needs, lack of parts or manpower, etc.
CSRT	Combat systems readiness test - A coordinated system testing program developed to insure that units deploy in a high state of combat system readiness.
CTF	Commander Task Force
CTG	Commander Task Group
CTU	Commander Task Unit

Cu-Ni	Copper nickel alloy
CUP	CSMP utilization percentage - An overall quantitative evaluation of the CSMP entries adjudged satisfactory divided by the total number of evaluated entries.
CWI	Continuous wave illumination (radar)
DART	Detection action response technique - established for action on continuing serious material problems. Program provides intensified management to resolve selected problems.
DC	Damage control
DCA	Damage control assistant
DCPO	Damage control petty officer
DFS	Direct fleet support
DISC	Discrepancy identification and corrections systems-SUPSHIP and shipyard formalized system of recording shipyard work discrepancies.
DPMA	Docking phased maintenance availability
DPMF	Docking phased maintenance availability fixed price contract
DPSC	Data processing support center - Processes NDCS documents submitted by ships and activities located in MIDPAC.
DSOT	Daily system operability tests - One of several system operability tests (SOT) required to ensure complete weapon system readiness.
DSRA	Docking selected restricted availability
ECP	Engineering change proposal
EDTA	Ethylenediaminetetra-acetate - Used for propulsion boiler cleaning. Classified as a mechanical cleaning method for boiler water chemistry purposes.
EGL	Equipment guide list - A 5 x 8 card which is used with a controlling maintenance requirements card for those equipments made up of a number of

identical items, i.e. motors, life rafts, valves, etc to indicate location of equipment; each EQL includes only that maintenance which can be done in one work day.

EIB — Electronic information bulletin - Contains information on new equipment advance notices of field changes, unusual casualties, and new servicing techniques.

EIC — Equipment identification code - An alpha-numeric code used in the 3-M system to identify system, subsystem, and the equipment in which maintenance is performed.

EIM — Electronics installation maintenance book - Contains detailed instructions for maintenance and repair of electronics equipment.

EOC — Engineered (or extended) operating cycle - A maintenance program that extends time between overhauls.

EOCC — Engineering operation casualty control

EOP — Engineering operating procedure

EOS — Enclosed operating station

EOSS — Engineering operation sequencing system

ESI — Explosive safety inspection

ETR — Estimated time of repair

FBR — Feedback report

FC — Field change

FCA — Field calibration activities

FCIG — Field change identification guide - List of all field changes applicable to each electronic equipment.

FCT — Final contract trial

FMCL — Fleet mechanical calibration laboratory

FMP — Fleet modernization program - Implementation of strategic military and technical improvements.

FMPMIS	Fleet modernization program management information system used to schedule and control the installation of alterations (SHIPALT's, MACHALT's etc.)
FMS-RT	Fleet management system, real time
FOB	Free on board (at delivery point)
FSN	Federal stock number -see NSN (national stock number)
FTGECCET	Fleet training group engineering casualty control evaluation team
GFI	Government-furnished information
GFM/GFE	Government-furnished material or equipment
GPM	Gallons per minute
GPETE	General purpose electronic test equipment
GSE	Ground support equipment
HABALT	Habitability alteration - Ship alterations involving shipboard habitability improvements.
HALON	Liquified bromotrifluoromethane
HM&E	Hull, mechanical, and electrical
HP	Horsepower
HCFF	High capacity fog foam system
IDD	Interim dry docking
IEH	Inactive equipment maintenance- A system of reduced PMS based on equipment inactivity.
IFB	Invitation for bids
IIMPP	Insurance item management program for parts
IIMPE	Insurance item management program for equipment
IMACC	Intermediate maintenance activity coordinating center

IMAV	Intermediate maintenance activity availability - Maintenance performed between overhauls by tenders or a SIMA.
IMMS	Intermediate maintenance activity management system -Comprised of computerized procedures used aboard tenders,repair ships, and repair bases/activities. Used to manage the planning, scheduling, production and monitoring of the maintenance workloads of tended ships.
INCHOP	Coming into geographical area under control of a different operational command
ISEA	In-service engineering agent
INSURV	Inspection and survey - Material inspection for purpose of apprising the Chief of Naval Operations of ships material condition.
ISIC	Immediate superior in command
ITP	Integrated test plan
ITPD	Integrated test planning document
JAG	Judge Advocate General
JCN	Job control number - Consists of the GIC (unit identification code) , WC (work center) , and JSN (job sequence number)
JSN	Job sequence number - A four-digit sequential number assigned to work requests at the work center level. This entry is an integral part of the JCN and is used for identification purposes.
LAPS	Louis-Allis power supply
LLTA	Long lead time actions - Action taken to assure material, software or required tool are available as required for maximum cost effectiveness of manpower or material.
LLTM	Long lead time material - Material that has a procurement lead time greater than five months starting with the receipt of the material requisition by the contracting or procurement activity.

LOA	Light-off assessment- an evaluation by ISIC of lightoff readiness
LOE	Light-off examination - An exam conducted by the Propulsion Examination Board (PEB) prior to lighting the first fire in any boiler or starting main propulsion diesel/gas turbine engine during a regular overhaul, major conversion or fitting out availability.
LOGSAT	Logistics special assistance team
LP	Low pressure
LRMS	Long range management system
2M	Miniature/microminiature electronic modules
3-M	Maintenance and material management system - system used throughout Navy for controlling repair, preventative maintenance support which assures maximum equipment operational readiness 3M Corp.
3-M	Minnesota Mining and Manufacturing Corporation
MAM/RSS	Maintenance assistance modules/ready service spares
MCA	Material condition assessment
MDCS	Maintenance data collection subsystem - Provides a means for maintenance personnel to record information about preventive or corrective maintenance actions.
MEASURE	Measurement equipment automated system for uniform reporting and evaluation
METCAL	Metrology and calibration
METAL	Metrology requirements list
MHB 400	Type of 2-1/2 inch firefighting hose
MHR	Machinery history report

MIP	Maintenance index page - A brief description of the maintenance requirements card for each item of equipment, including the estimated man hours required, recommended rates, etc.
MIRCS	Mechanical Instrument repair and calibration shop
MJC	Master job catalog - Consists of standardized work that applies to more than one ship or performed on a repetitive basis.
MOT	Maximum operating time
MOTU	Mobile technical unit - Provides technical assistance and on-the-job training for shipboard personnel to increase the efficiency and reliability of fleet electronic and weapons systems.
MOU	Memorandum of understanding
MPRR	Main propulsion readiness review
MRC	Maintenance requirement card - Provides detailed procedures for performing a maintenance requirement and tells what, how, by whom and with what resources a specific requirement is to be accomplished.
MSD	Marine sanitation devices
N2	Nitrogen
NAMSO	Navy Maintenance Support Office, repository of Navy Maintenance Data
NAVMASSO	Navy Maintenance and Supply System Office
NARDAC	Navy Area Regional Data Automation Center - Processes MDS documents submitted by ships and activities.
NAVELEX	Naval Electronic Systems Engineering Center
NAVFORSTAT	Naval force status report
NAVMMAC	Navy Manpower and Material Analysis Center -Under the command of the CNO and assigned 3-M System task.

NAVSEA	Naval Sea Systems Command - Responsible for executing the overhaul schedule, established by CNO, in a naval shipyard or at a SUPSHIP activity.
NAVSEACEN	Naval Sea Support Center- Provides technical assistance for engineering, electronics and weapons.
NAVSEC	Naval Ship Engineering Center
NAVSEEACT	Naval Shore Electronics Engineering Activity
NAVSSES	Naval Ship Systems Engineering Station (formerly NAVSEC Philadelphia, PA)
NCB	National Codification Bureau - A two digit number designating the NATO country which cataloged the item.
NCR	No calibration required
ND	Navy distillate fuel
NEC	Navy enlisted classification - A four-digit number which identifies a skill held by an enlisted person.
NIIN	National item identification number - The NCB number (two digits) combined with 7 other digits.
NIS	Not in stock
NOTRL	Not to all
NPMTT	Nuclear power mobile training team
NSN	National stock number - The part/material identifier, consisting of cognizance symbol (COG), federal supply classification (FSC) , national item identification number (NIIN) , and special material identification code (SMIC) if applicable.
NSTM	Naval ships technical manual
NSWSES	Naval Ship Weapon Systems Engineering Station - Provides technical assistance for all combat system and UNREP equipment. Conducts gun systems operability tests (GSOT) , and ship qualification trials (SQT) in missile ships.

NTDS	Naval tactical data system
NWP	Naval warfare publications
OAR	ORDALT accomplishment requirements
OBA	Oxygen breathing apparatus
OCSOT	Overall combat systems operability test
OD	Ordnance document
OFRP	Overseas family residency program
OIC	Officer in charge
OLM	Organizational level maintenance - Maintenance performed by ships force personnel.
OMMS	Organizational maintenance management system
OMT	Organizational maintenance training or overhaul management team
OP	Ordnance publication
OPNAV4790/CK	Ships configuration change form
OPNAV4790/2Q	Ship's maintenance action form - A multiple-purpose form used to report deferred and completed maintenance actions, configuration changes and completed or partially completed alterations.
OPNAV4790/2R	Automated work request- Computer-produced and displays the information submitted in OPNAV 4700/2K
OPORD	Operation order
OPPE	Operational propulsion plant examination
OPTAR	Operating target
ORDALT	Ordnance alteration - Consists of an ORDALT instruction (drawings, test procedures, directions) and an ORDALT kit (material and documentation required to perform an ORDALT).
ORDSAT	Ordnance special assistance team

ORDSER	Ordnance support element review
PEB	Propulsion Examination Board - A board on the fleet commander's staff tasked by CNO to determine the state of training and qualifications of propulsion plant personnel and the materiel condition of the ship's propulsion plant.
PECP	Preliminary engineering change proposal
PERA	Planning and engineering for repairs and alterations. Chartered to assist with overhaul and major availability work package development for designated ship types.
PIEZOMETER	An instrument for measuring pressure or compressibility
PIMI	Pre-inactivation material inspection
PMA	Phased maintenance availability scheduled by CNO in accordance with a class maintenance plan
PMF	Phased maintenance availability fixed price contract
PMS	Planned maintenance system - Provides each user with basic and standard means for planning, scheduling, controlling and performing planned maintenance of all equipment.
POA&M	Plan of action and milestones - Provides a plan of action, individual code responsibilities, and milestone dates for implementing the plan.
POT&I	Pre-overhaul test and inspection - A program of test and inspections of particular equipments, systems, or sections of a ship conducted by ship's force and cognizant inspectors/technical personnel to assist the commanding officer in determining the material condition and extent of repairs required during an assigned availability.
PPH	Parts per hundred
PPM	Parts per million
PPR	PMS performance rate - An overall quantitative evaluation of the actual performance of planned maintenance require for accomplishment.

PQS Personnel qualification standard

PRAV Planned restricted availability - Availabilities assigned by COMNAVSURFPAC for the accomplishment of specific tasks of relatively major proportions,. e.g. major depot level repairs, designated title D, F and K alterations. and alterations equivalent to repair (AER).

PRIORITY The code designator from OPNAVINST 4790.4A which is applicable to the maintenance item.

PRIORITY CODE	DESCRIPTIVE PRIORITY
1	MANDATORY
2	ESSENTIAL
3	HIGHLY DESIRABLE
4	DESIRABLE

PRL Publications requirement list

PSA Post-shakedown availability

PSIG Pounds per square inch gauge

PUBSAT Publication special assistance team

QA Quality assurance

QPL Qualified products list

RA Restricted availability

RAC Repair, alignment and calibration Special program designed to assist in maintaining the operational readiness of the AN/SQS-26 (series) sonar systems.

RAV Restricted availability - Assigned for the accomplishment of specific. items of work by an industrial activity with the ship present.

RAR Recorded accomplishment rate - The percentage of the PMS scheduled during the period under examination which is recorded as accomplished.

RCM Reliability centered maintenance

REFTRA Refresher training

RFI Ready for issue

RFP	Request for proposal
RIP	Repair inspection requirements - Pages in the FOT&I plan which provide criteria for conducting inspection and tests.
ROH	Regular overhaul
RPM	Revolutions per minute
RSG	Readiness support group
SAIL	Ship's armament inventory list- Installed equipment and all ORDALT's accomplished.
SARP	Ship's alteration and repair package - Displays the ships total work package showing all work that has been identified, screened to the various repair activities and authorized for accomplishment or disapproved.
SCAT	Sonar calibration alignment training
SFWP	Ship's force work package
SHIPALT	Ship alteration - Changes in hull, machinery, fittings or equipment involving changes in design, material, number, location or relationship of component parts.
SHIPALT(D)	Authorized and funded by COMNAVSURFPAC with Naval Operation and Maintenance Funds (O&MN). Performed by forces afloat, or by shipyards as designated.
SHIPALT(F)	An alteration to a ship performed by forces afloat; does not require special program material; authorized by COMNAVSURFPAC; no industrial assistance required.
SHIPALT(K)	An alteration to ship authorized and funded by NAV5EA. Usually requires procurement of special program material by NAVSEA. Performed by forces afloat or by shipyards; requires specific authorization by NAVSEA.
SID	SHIPALT installation drawing

SIMA	Shore intermediate maintenance activity - Shore based facility manned by skilled Navy personnel; augments fleet intermediate maintenance capability.
SITREP	Situation report
SMAF	Ship's maintenance action form
SMMO	Ship's maintenance management officer
SNAP	Shipboard non-tactical APP system
SOE	Standard option equipment/central procured
SORAP	Sonar repair and alignment program
SOT	Systems operability tests
SPCC	Ships parts control center
SPETERL	Ships portable electrical/electronic test equipment requirements list
SPM	Special program material
SQT	Ship qualification trials - Purpose is to provide the CO of each ship completing construction, conversion or overhaul with timely and competent assistance in achievement of a high level of weapons systems readiness.
SRA	Selected restricted availability - An availability of approximately 6 to 12 weeks in duration scheduled by CNO approximately once each 12 to 18 months.
SRF	Ship repair facility - Industrial activities located overseas with capabilities very similar to naval shipyards in the U.S. The SRF's are capable of overhauling most ships, being limited only by available manpower and shop capacity.
SS	Stainless steel
SSCI	Ships system configuration index
SSD	Survival support devices
SSR	Ship's selected records

SSTG	Ship's service turbine generator
SUADPS	Supply Uniform Automated Data Processing System
SUPSHIP	Supervisor of shipbuilding, conversion and repair -Coordinates and arranges all contacts and dealings with private shipyard contractors.
SWAB	Ship work authorization boundary - A system, based on SWBS, for uniform packaging of depot level work.
SWBS	Ship work breakdown structure - A single language numbering system for classifying the functional segments of a ship, e.g. structure, systems, machinery, armament, etc. SWBS categories are identified by three-digit numbers.
SWI	Standard work item - SUPSHIP work specifications prepared to describe the work scope associated with a specified level of repair to specific equipment or systems or with installation of a specified alteration in a specific class of surface ship.
WSAT	Weapons system accuracy trials - Purpose is to demonstrate the operational accuracy of a ship's ASW weapon system.
WWP	WESTPAC work package

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